AD-A136 931 INSTALLATION RESTORATION PROGRAM PHASE I RECORDS SEARCH OTIS AIR NATIONAL GUARD BASE MASSACHUSETTS(U) METCALF AND EDDY INC BOSTON MA JAN 83 DAHA19-82-C-0015 1/2

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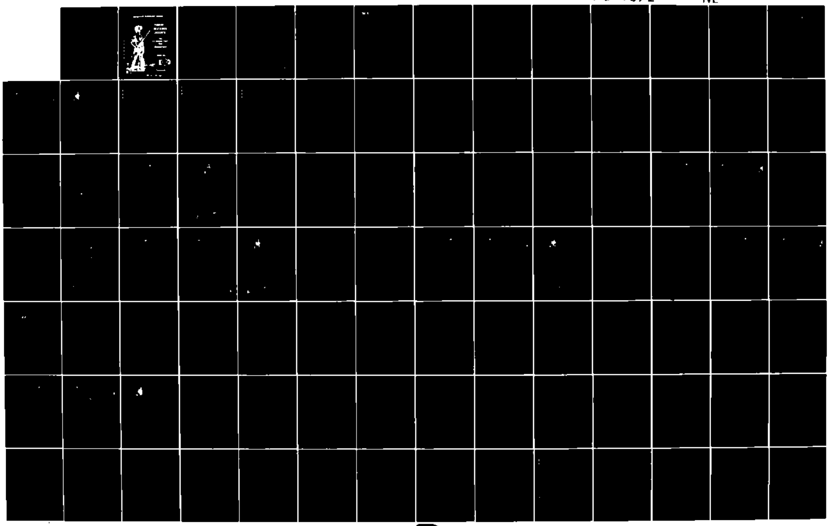

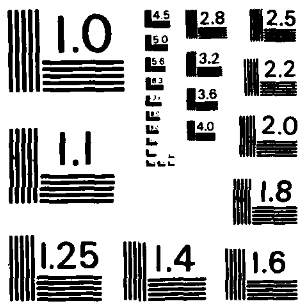

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

AD A136931

This report has been prepared for the Air National Guard by Metcalf & Eddy Inc., for the purpose of aiding in the implementation of the Installation Restoration Program. It is not an endorsement of any product. The views expressed herein are those of the contractor and do not necessarily reflect the official views of the Air National Guard or the Department of Defense.

INSTALLATION RESTORATION PROGRAM
PHASE I – RECORDS SEARCH
OTIS AIR NATIONAL GUARD BASE
MASSACHUSETTS

Prepared for

OTIS AIR NATIONAL GUARD BASE
MASSACHUSETTS

January 1983

By

METCALF & EDDY, INC.
50 Staniford Street
Boston, Massachusetts 02114

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Metcalf & Eddy, Inc.
Engineers & Planners

50 Staniford Street
Boston, Massachusetts 02114
TWX 710 321 6365
Cable METEDD Boston
Telex 681 7067 (METED UW)
Telephone (617) 367 4000

February 14, 1983

LTC Philip J. McNamara
Base Civil Engineer
102 CEF Building 971
Otis Air National Guard Base
Massachusetts 02542

Dear LTC McNamara:

We are pleased to submit this Final Report entitled "Installation Restoration Program, Phase 1 Records Search, Otis Air National Guard Base, Massachusetts". This report was prepared in accordance with our proposal dated December 21, 1981, and Departments of the Army and the Air Force National Guard Bureau Contract No. DAHA 19-82-C-0015.

This report is divided into chapters per your suggested report format. Included is introductory background information on the Installation Restoration Program; a description of Otis ANG Base including history and mission; the environmental setting; a review and evaluation of past site waste disposal practices; an identification of sites where there is potential for environmental contamination; and recommendations for Phase II, Problem Confirmation, of the Installation Restoration Program.

We appreciate the opportunity to participate in the Installation Restoration Program at Otis Air National Guard Base and look forward to working with you again.

Very truly yours,

METCALF & EDDY, INC.

Richard L. Ball

Richard L. Ball, Jr.
Vice President

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[illegible]

The Department of Defense (DOD) has developed a program to identify and evaluate past hazardous material sites on DOD property, to control the migration of hazardous contaminants, and to control hazards to health or welfare that may result from these past disposal operations.

This program is called the Installation Restoration Program (IRP). The IRP has four phases consisting of Phase I, Initial Assessment/Record Search; Phase II, Problem Confirmation; Phase III, Technology Base Development (optional); and Phase IV, Operations. [illegible] (M&E) was retained by Otis Air National Guard Base to conduct a Phase I study at Otis Air National Guard Base under Contract No. DAHA 19-82-C-0015.

Environmental Setting

The key elements of the environmental setting at Otis ANG Base relative to [illegible] are:

- The [illegible] beneath the base are [illegible] with high permeabilities.
- [illegible] constitute an [illegible] of [illegible]
- [illegible]


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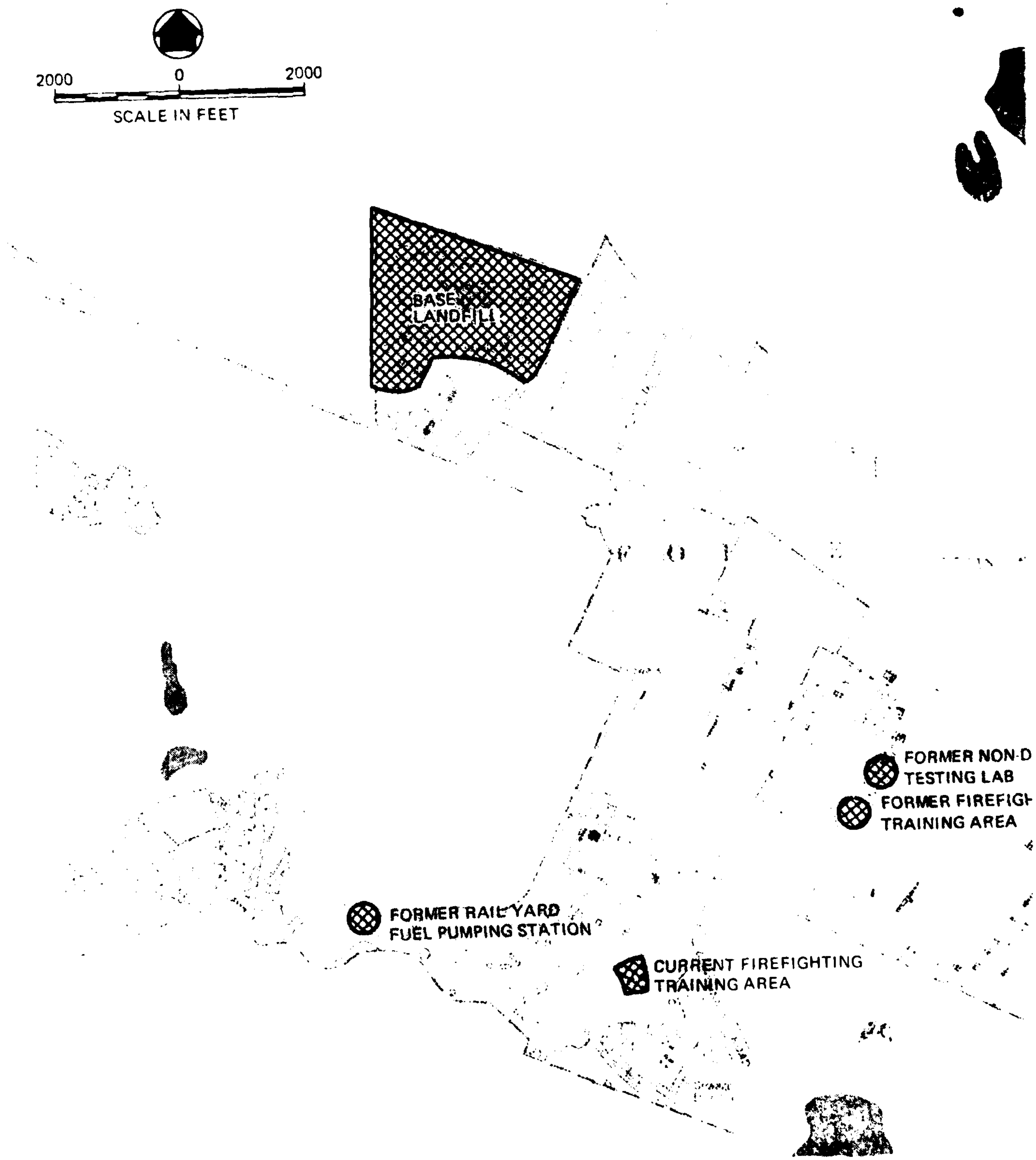
2000
SCALE IN FEET
BASE
LANDFILL
FORMER RAIL YARD
FUEL PUMPING STATION



2000
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SCALE IN FEET
BASE LANDFILL
FORMER NON-D
TESTING LAB
FORMER FIREFIGH
TRAINING AREA
FORMER RAIL YARD
FUEL PUMPING STATION
CURRENT FIREFIGHTING
TRAINING AREA

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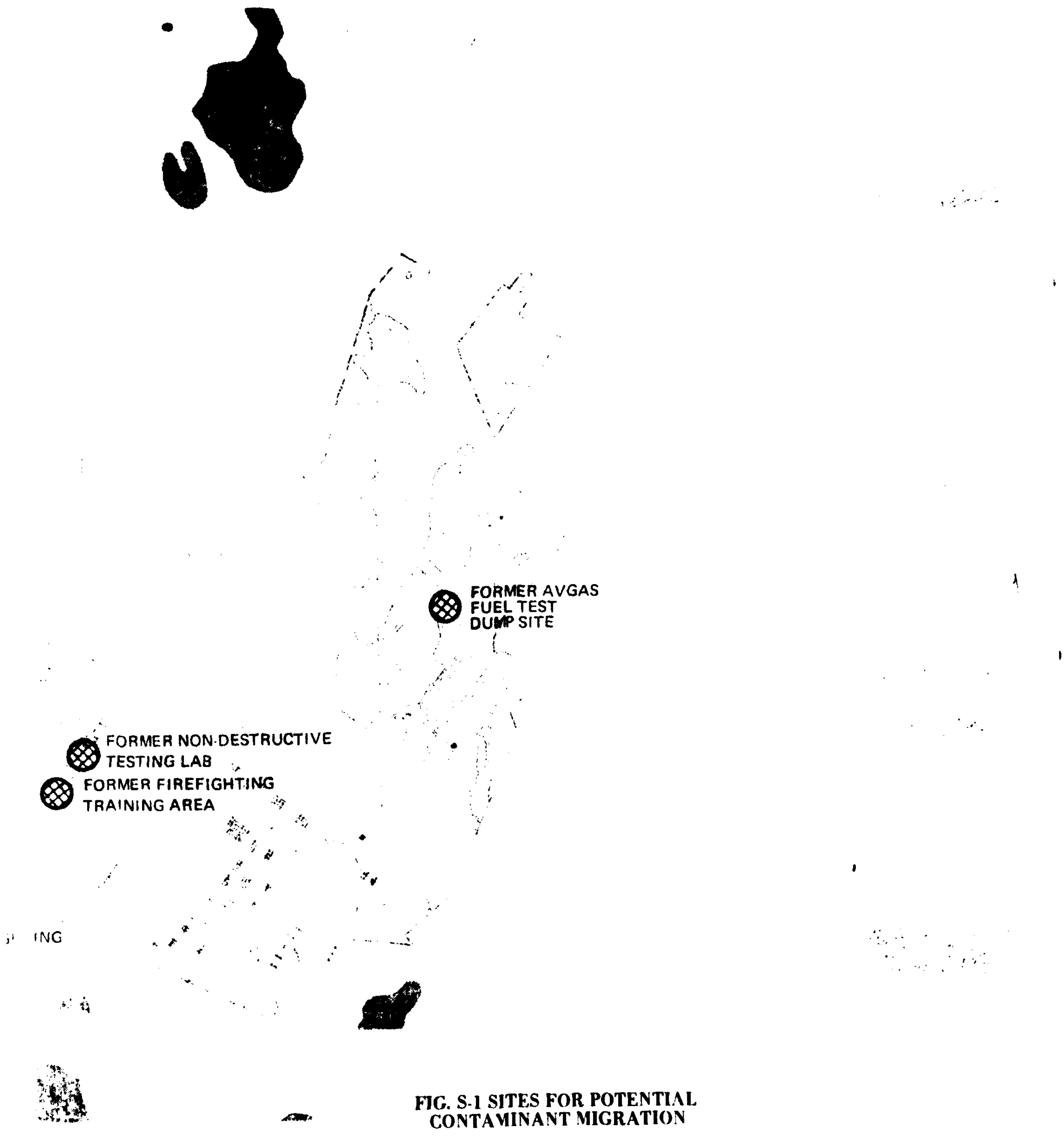

FIG. S-1 SITES FOR POTENTIAL CONTAMINANT MIGRATION

3

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[illegible] PRIORITY RANKING OF POTENTIAL CONTAMINATION SOURCES

[illegible]	Date of operation or occurrence	Overall total score
[illegible] Firefighting Training [illegible]	1958-Present	81
[illegible] Firefighting Training [illegible]	1950(?)-1958	76
[illegible] Landfill	1960-Present	[illegible]
[illegible] Site	[illegible]-1970	71
[illegible]	[illegible]	70
[illegible] Test Lab	1959-1970	62

[illegible] according to the Hazardous Assessment Rating [illegible] in Appendix D. Individual site rating forms [illegible] in Appendix E.

[illegible] Area

[illegible] Area

[illegible]

[illegible] Section

[illegible] Site

[illegible] Lab

[illegible]

[illegible] regarding additional studies to confirm and [illegible] migration from the sites that we have iden- tified and [illegible] as follows:

[illegible]	Drill borings and install
[illegible]	monitoring wells [illegible] of
[illegible]	and [illegible] from sites.
[illegible]	[illegible] for residual
[illegible]	contamination.
[illegible]	
[illegible]	[illegible]
	[illegible]
	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

REPORT

CHAPTER 1

INTRODUCTION

Background and Authority

Federal, state and local governments have developed strict regulations requiring that disposers identify the locations and contents of disposal sites and take action to eliminate the hazards in an environmentally responsible manner. The Department of Defense (DOD) has issued Defense Environmental Quality Program Policy Memorandum 81-5 which requires the identification and evaluation of past hazardous material disposal sites on DOD property, the control of migration of hazardous contaminants, and the control of hazards to health or welfare that resulted from these past operations. This program is called the Installation Restoration Program (IRP). The IRP will be a basis for response actions on Air Force Installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980.

Purpose and Scope

The Installation Restoration Program (IRP) has been developed as a four-phased effort. Phases II, III and IV will be carried out only if found necessary in the previous phase. The phases are as follows:

Phase I - Initial Assessment/Records Search

Phase II - Problem Confirmation

Phase III - Technology Base Development

Phase IV - Operations (Control Measures)

Figure 1-1 illustrates the decision tree that is the basis for analyzing sites under the Phase I program. The decision tree shows the methodology for determining whether sites are deleted from or included in the Phase I analysis.

Metcalf & Eddy (M&E) was retained by Otis Air National Guard Base to conduct a Phase I Study under Contract No. DAHA19-82-C-0015. This report contains a summary and an evaluation of the information collected for Phase I.

The goal of the first phase of the program is to identify areas of potential contamination, evaluate the environmental hazard, and assess the need for future action. The activities undertaken in Phase I include the following:

- Review site records.
- Interview past and present personnel familar with Base waste disposal activities.
- Determine quantities and locations of past hazardous and other waste storage, treatment and disposal.
- Define the environmental setting at the Base.
- Review past disposal practices.
- Gather pertinent information from federal, state and local authorities.
- Identify areas of potential contamination.
- Evaluate potential for contaminant migration.
- Make recommendations for future action.

Metcalf & Eddy assembled the following team to perform the work entailed under Phase I:

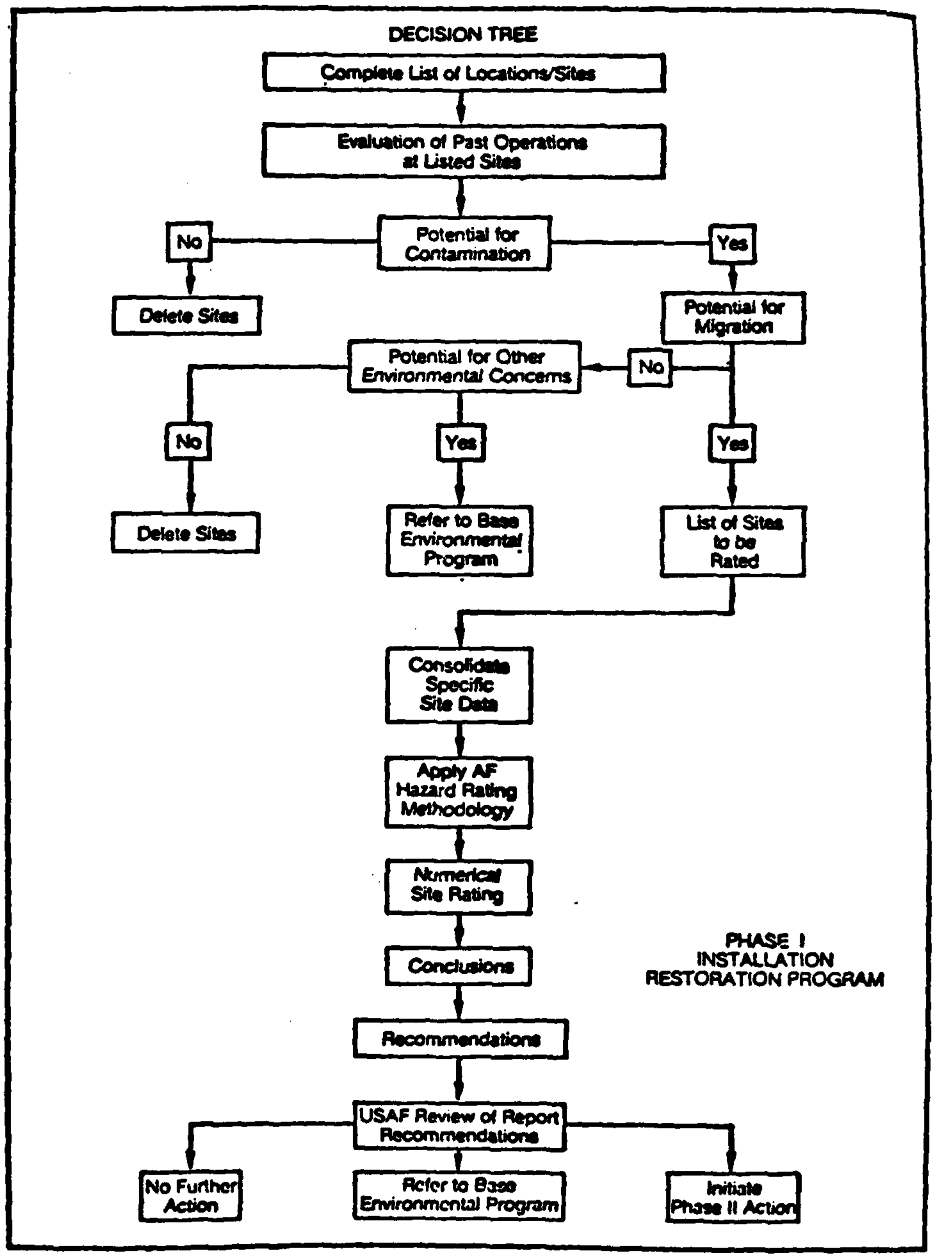


FIGURE 1-1 RECORDS SEARCH METHODOLOGY

- R. L. Ball, Project Principal, MS Water Resource Engineering, 20 years professional experience.
- W. F. Diesl, Project Hydrogeologist, MS Geology, 7 years of professional experience.
- M. J. Meagher, Solid Waste Engineer, BS Civil Engineering, 17 years of professional experience.
- R. G. Sherman, Geologist, BS Geology, 29 years of professional experience.
- E. J. Cichon, Chemist, PhD Chemistry, 6 years of professional experience.
- A. Michelini Jr., Chemist, BS Bacteriology, 24 years of professional experience.

Resumes for these individuals are included in Appendix A.

Phase I work began with a search of the Otis ANG Base records. The records consisted of maps and air photos of the Base from various time periods; water quality data; and various reports. Table 1-1 is a list of all reports and records that were reviewed.

The next step in the study was to determine the past mamagement practices regarding the use, storage, treatment, and disposal of hazardous and other waste materials from the various operations on the Base. Past and present disposal sites and any other sources of possible contamination were identified.

Information was then obtained by interviewing 28 past and present Base employees from the various operating areas of the Base. Those interviewed are or were associated with the Base

TABLE 1-1. RECORDS SEARCH DATA PROVIDED BY OTIS ANGB

1. Base Map, no title, 1" = 400' (updated to 1981)
2. Base Map, title "Otis Air Force Base, Jan 1973", 1" = 400'
3. Real Estate Map, Otis Air National Guard Base, 1981
4. SPECIFIC SITES, Phase I Records Search, Annotation on 1967 Pocasset Quadrangle
5. Listing of Current Otis Federal Employees to be interviewed.
6. Listing of Former Otis Federal Employees and Position Held to be interviewed
7. Base Telephone Directory
8. Publication - "Air Installation Compatible Use Zone, Otis Air Force Base, Mass. - AICUZ Sept 1980"
9. Report - "1976 Veterans Administration National Cemetery of Bourne, Massachusetts" (10 pages, selected data on site, base history, land use).
10. Water-Table Map of Cape Cod, Massachusetts, Cape Cod Canal to the Bass River, May 23-27, 1976
11. "G" Well Water Quality Data
12. Drawing (print) of Sanitary Landfill Site 1" = 200'
13. Information on Base Sanitary Landfill (7 pages)
14. "Superfund" Site Reporting Notification of Hazardous Waste Site", dtd 29 May 81.
15. "Notification of Hazardous Waste Activity", dtd 17 Sept 81
16. Abstract (1 page) "Dissolved Substances in Ground Water Resulting from Infiltration of Treated Sewage," by Denis R. LeBlanc, U.S. Geological Survey.
17. Aerial Photography (1 sheet) 10/22/51 DPL-2K-80
18. Aerial Photography (1 sheet) Uncontrolled Mosaic, Aerial Photography 28 May 57
19. Aerial Photography (4 Obliques) titled "551st AEW&C Wing 29 Oct 59 135 mm 8000', Otis AFB".

20. Aerial Photography (1 sheet) DPL-2LL-29 dtd 10-6-70

21. Aerial Photography (1 sheet) 23/R 6 July 80

22. Map - Pocasset quadrangle, 1953

23. Map - Pocasset quadrangle, 1967, Photorevised 1979

24. Map - Falmouth Quadrangle, 1972, Photorevised 1979

25. Map - (Quadrangle) Camp Edwards Special Map V 814S, Edition 2 - DMA, Data 1972, 1974

26. Map - (quadrangle) Camp Edwards Special Map Series V814S, Edition 1 - AMS, revised in 1949 by photoplanimetric methods from aerial photography dated 1947

27. Map (has 2 sides) - Photo Map, Pocasset (Camp Edwards and Vicinity), AMS V014A, aerial photography October 1947; and Pocasset quadrangle, compiled in 1948 from aerial photography Sept - Oct 1947.

28. Photo Map, Pocasset, AMS V 014A, aerial photography Oct 1947, restricted edition.

29. Print, Camp Edwards and Vicinity, dated May 12, 1949

30. Subsurface Discharge Permit Application - Otis Air National Guard Base Wastewater Treatment Plant, Oct. 2, 1981.

31. Report - "Soils and Their Interpretations for Various Land Uses - Camp Edwards", December 1980, with aerial Atlas Sheet No. 19 and No. 26 (by U. S. Department of Agriculture, Soil Conservation Service)

32. Final Environmental Impact Statement, Wastewater Collection and Treatment Facilities, Falmouth, Massachusetts, August 1981; note pgs. 7-8.

33. Architect-Engineer's Report on Camp Edwards, June 4, 1941, 284 pgs.

34. Management for Site Investigations: The Preliminary Site Assessment, Part A and Part B, Commonwealth of Massachusetts, Executive Office of Environmental Affairs, Department of Environmental Quality Engineering, Division of Hazardous Waste, November 1980.

35. Groundwater & Groundwater Law in Massachusetts, 2nd Edition, Commonwealth of Massachusetts, Water Resources Commission, Division of Water Resources, 1979.

36. Cape Cod Waste Water Renovation and Retrieval System, A Study of Water Treatment and Conservation, Woods Hole Oceanographic Institution, Woods Hole, Mass., August 1977 (Report on a spray irrigation project at Otis Air Force Base, conducted under a grant from the U.S. Environmental Protection Agency).

37. From U.S. Geological Survey, Water Resources Division, Boston, Mass.; Chemical Quality of Ground Water on Cape Cod, Massachusetts, 1979; Chemical Analysis of Groundwater, Cape Cod, Massachusetts, 1978; Evaluation of Data Availability and Examples of Modeling for Groundwater Management on Cape Cod, Mass., 1975; Groundwater Management - Cape Cod, Martha's Vineyard and Nantucket, 1973; Water Table Map of Cape Cod, 1977.

38. Water Quality Management Plan for Cape Cod, Draft Plan, Final Plan (Volume 1 and Volume 2) 1978. (Comprehensive plan for Water Quality Management prepared under Section 208 of P.L. 92-500 (The Clean Waters Act)). Cape Cod Planning & Economic Development Commission, Barnstable, Massachusetts.

39. Sewage Plume in a Sand and Gravel Aquifer, Cape Cod, Massachusetts, Denis R. LeBlanc, U.S. Geological Survey Open File Report 82-274, 1982.

40. Moncevicz, Donald W., 1982, 102 Fighter Interceptor Wing/ Civil Engineering, Hazardous Waste Study and Inventory, Otis ANG Base Internal Working Paper.

41. "J" Well Water Quality Data.

42. Department of Environmental Quality Engineering Hazardous Waste Regulations, Massachusetts Register, July 1, 1982.

civil engineering functions, including electrical, mechanical, plumbing, construction services, firefighting, fuels maintenance, and pavement and grounds (including the landfill). Fuels management, the Defense Property Disposal Office, and the Base Public Affairs Office also supplied representatives to be interviewed.

Representatives of applicable federal, state and local agencies were contacted and interviewed for pertinent Base related environmental data. The agencies contacted are listed as follows:

U.S. Geological Survey (Mr. Denis Leblanc, Hydrologist, 617-223-4521)

U.S. Environmental Protection Agency (Mr. John Hackler, Chief, Site Response Section, Region 1, 617-223-0031)

Massachusetts Department of Environmental Quality Engineering (Mr. Joseph Conley, Acting Chief, Water Supply Section, Southeast Region, 617-947-1231)

Cape Cod Planning and Economic Development Commission (Mr. Scott Horsely, Water Resources Coordinator, 617-362 2511)

A general reconnaissance of identified sites was made by the M&E Project Team to gather site specific information including 1) visual evidence of any environmental stress or 2) the presence of nearby drainage ditches or surface-water bodies, and a visual inspection of these water drainage paths for any obvious signs of contamination or leachate migration.

The decision tree shown in Figure 1-1 was then used to determine which sites should be rated using the Hazardous Assessment Rating Methodology (HARM) model, which sites should be deleted, and which sites should be referred to the Base environmental program. Details of the model are included in Appendix B. The decision to rate the site was based on the potential for hazardous material contamination at the site and on the potential for migration of the contamination. A site could be deleted from consideration for rating on either basis.

For those sites where a potential for contamination was identified, a determination of the potential for migration of the contamination was made by considering site-specific conditions. If the potential for contaminant migration was considered significant then the site was evaluated using the HARM.

The HARM score indicates the relative potential for environmental hazard at each site. For those sites showing a high potential, recommendations are made to confirm the potential contaminant migration problem under Phase II of the Installation Restoration Program. For those sites showing a moderate potential for environmental hazard, a limited Phase II program is recommended to confirm that such a hazard does or does not exist. For those sites showing a low potential, no follow-up Phase II work is recommended.

CHAPTER 2

INSTALLATION DESCRIPTION

Location, Size, and Boundaries

Otis Air National Guard Base is located on Cape Cod, 60 miles south of Boston (Figure 2-1). The Towns of Falmouth, Bourne, Mashpee and Sandwich abut the Base controlled property.

The Base encompasses approximately 3,230 acres including easements (shaded area in Figure 2-2). About 33% is owned by the U.S. Air Force. The remainder is owned by the Commonwealth of Massachusetts and leased to the U.S. Air Force. The Army National Guard (Camp Edwards) and the U.S. Coast Guard Air Station are contiguous to Otis ANG Base. Present land areas adjacent to the Base are primarily as follows:

North - Camp Edwards located in the Towns of Bourne and Sandwich

West - Camp Edwards in the Town of Bourne and the Veterans Administration National Cemetery

South - Rural areas of Falmouth and Mashpee

East - Rural areas of Mashpee

Base History

Information concerning the history of the Base was taken largely from the Air Installation Compatible Use Zone (AICUZ) study of 1980. The history of what today is Otis Air National Guard Base has two distinct elements, i.e., Otis Field and Camp Edwards. In 1935 a bill was passed by the Massachusetts Legislature to purchase the present land area from various owners

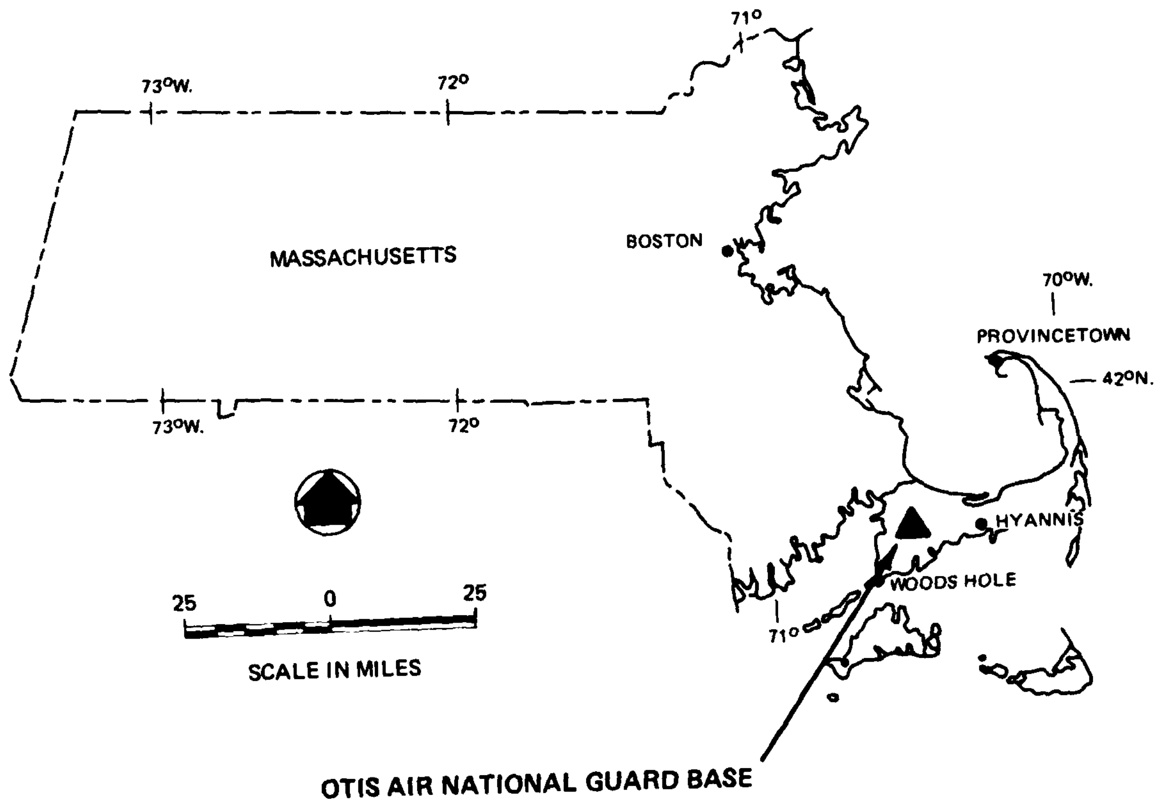
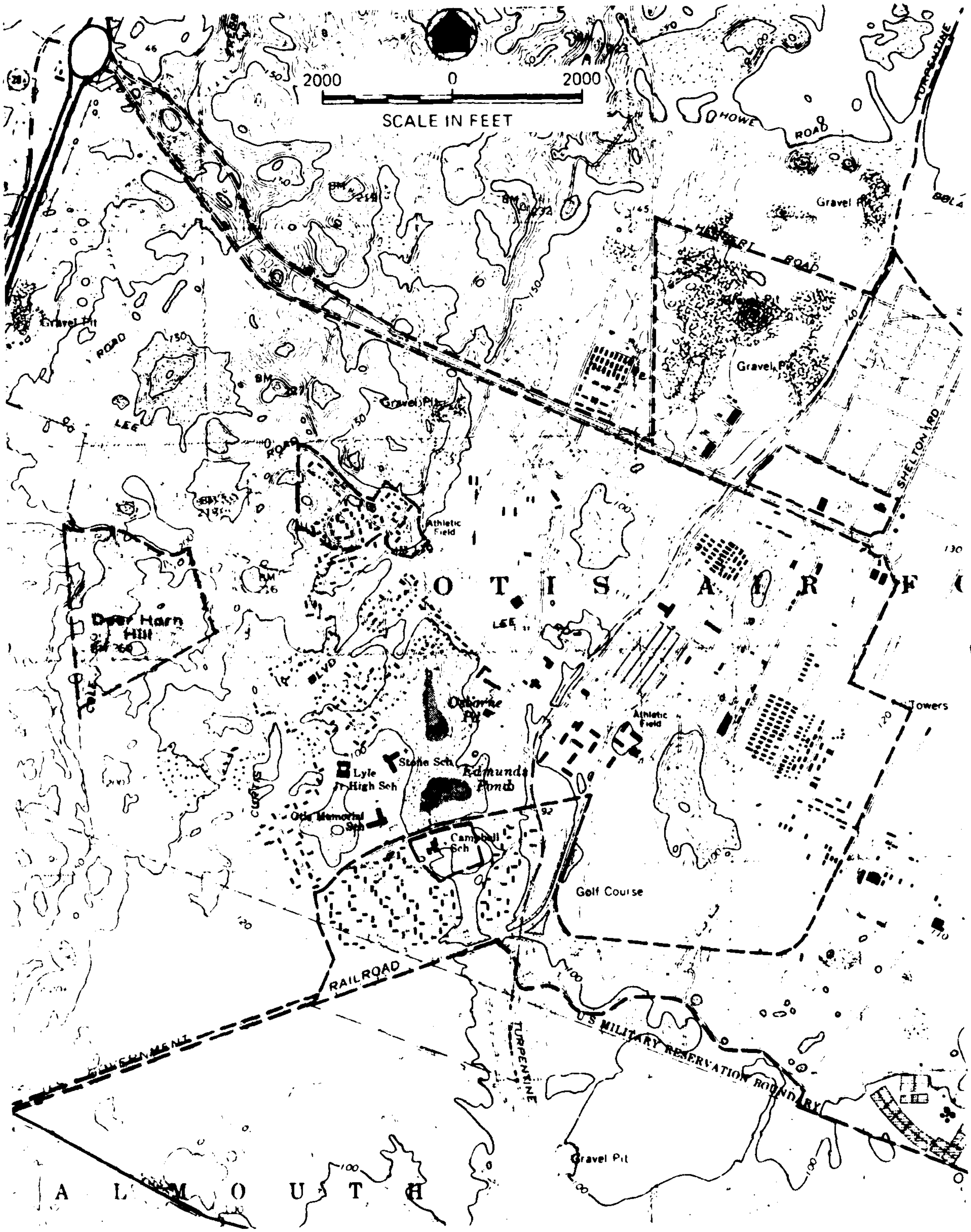


FIG. 2-1 OTIS ANG BASE LOCATION MAP



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HOWE ROAD
Gravel Pit
ROAD
LEE
Gravel Pit
Gravel Pit
Gravel Pit
SHELTON RD
Athletic Field
O T I S A I R F
LEE
Deer Horn Hill
BLVD
Osborne Pit
Athletic Field
Towers
Stone Sch
Lyle Jr High Sch
Edmunds Pond
Otis Memorial Sch
Campbell Sch
Golf Course
RAILROAD
TURPENTINE
U S MILITARY RESERVATION BOUNDARY
Gravel Pit
A L M O U T H

(1)

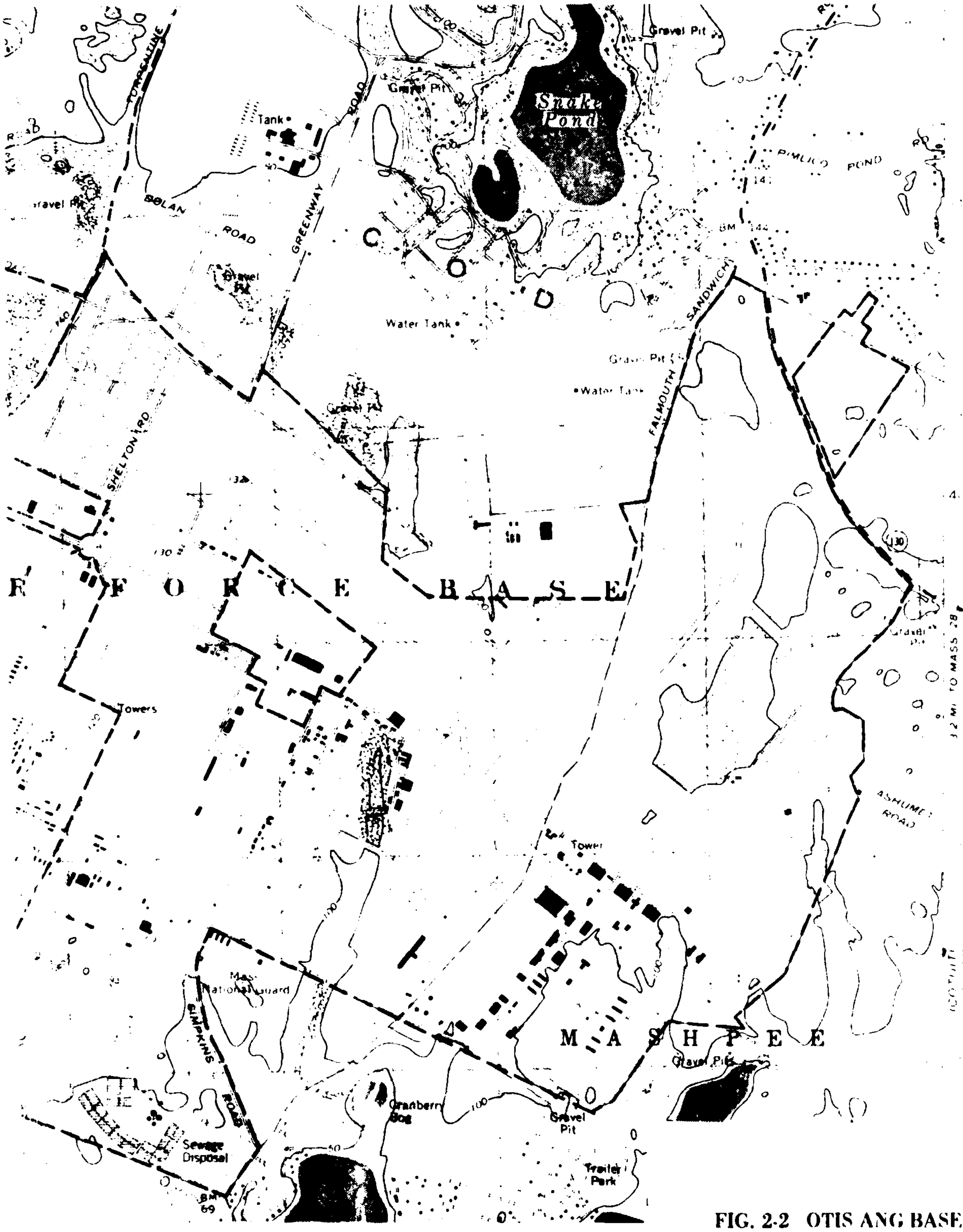


FIG. 2-2 OTIS ANG BASE SITE MAP

2

for establishment of a training site for the Massachusetts National Guard. The greatest part of the area was owned by the Coonamesset Ranch Co., which was reportedly the largest ranch east of the Mississippi River and was utilized for the raising of sheep. During the period 1935 to 1940, extensive use was made of the Works Project Administration, and a very serviceable camp site was created. The original landing strip that is now part of the multi-tenant, multi-purpose complex, known as Otis Field was constructed during this period. It consisted of 2 turfed runways, 500 feet wide, one 3,630 feet long and the other 3,890 feet long. Runway area was then approximately 79 acres. This area was used for training of the 101st Observation Squadron of the Massachusetts National Guard.

In 1940, the U.S. Army leased the land which included Otis Field from the Commonwealth and constructed Camp Edwards, a huge troop training center. The Federal Government constructed buildings, roads, utilities, ranges and a parade ground at a cost of $2,778,000 ($551,602 portion State funded).

In 1941, the Federal Government added dormitories and support facilities to accommodate 70,000 troops and a hospital complex with a 1722 bed capacity. At this point, the air facility served as a sub-base for Westover Field, Mass. On 30 April 1944, the facility was turned over to the Department of the Navy for the duration of the National Emergency.

In 1948, the U.S. Air Force obtained control of Otis Field with the assignment of a Fighter Interceptor Mission. Approach easements of approximately 68.5 acres were obtained for privately-owned lands off the northeastern end of Runway 05/23, which was extended from 7,000 feet to 8,000 feet.

As a means of satisfying the USAF's requirements for housing, storage and automotive maintenance, several buildings and land areas located on Camp Edwards were obtained by permit from the Department of the Army on 15 October 1948. As additional facilities were needed, amendments to this permit were made. Headquarters, First Army issued official notification that Camp Edwards would revert to caretaker status on 2 December 1952. The Air Force was given the opportunity to select the facilities required for Otis, and these were subsequently transferred from the Department of the Army to the Department of the Air Force under Public Law 155, 82nd Congress and Department of Defense Directive 4165.11, dated 21 November 1953. The action also involved the acquisition and operation of additional facilities and assumption of certain functions, activities, equipment and real estate which included operation of the following: water pumping and utility distribution systems, sewage disposal system, communication center (telephone exchange), supply facilities, coal yard, structural fire protection for Otis, the hospital and several commissaries.

The Massachusetts Air National Guard Permanent Field Training Site (PFTS), manned by 35 people, was established in March 1954. Its primary mission was to provide all necessary material except aircraft and personal equipment for Air National Guard units performing 15 day annual field training. Many units came from distant parts of the country to perform their training at Otis AFB, one of five bases in the country with a PFTS. Each year approximately 8,000 troops were supported by the PFTS, primarily during the months of July and August. The PFTS was deactivated on 1 April 1973.

In 1955, the 551st Airborne Early Warning and Control Wing was added to the defense team at Otis. The assigned EC-121 "Super Connies" extended land based radar coverage hundreds of miles to sea, providing protection against a surprise attack along the East coast. The year 1955 also marked the arrival of the 60th Fighter Interceptor Squadron.

In August 1956, the Air Force negotiated a 99 year lease with the Commonwealth of Massachusetts for approximately 19,700 acres, including Otis Field and Camp Edwards. Subsequently, the crosswind runway 14/32 was extended from 7,000 feet to 9,500 feet, and both runways were considered primary. A new control tower, fire station, hangars, nose docks, and an 1193 unit family housing area were constructed. The Air Force gave the U.S. Army a permit to utilize approximately 14,000 acres east and northeast of Connery Avenue.

In November 1962, when the 26th Air Defense Missile Squadron was activated, Otis became one of the few Air Defense Command Bases to have both a fighter squadron and BOMARC missile activities. The BOMARC activity was terminated on 30 April 1972.

Since 1968, Otis AFB has acted as host to a number of additional units. The 102nd Tactical Fighter Wing, Massachusetts Air National Guard arrived at Otis in August 1968 when its facilities at Logan International Airport were vacated. The

4713th Defense Systems Evaluation Squadron was added in 1970 after the 551st Airborne Early Warning and Control Wing was deactivated due to a planned phase out of certain units of the Aerospace Defense Command. Deactivation of the 60th FIS was completed on 30 May 1971. With the deactivation of the 551st AEW&C Wing, the 4784th Air Base Group assumed the role of host unit on 1 January 1970. In August 1970 the Coast Guard moved from Salem to Otis and commissioned the CG Air Station, Cape Cod. In December 1973 the 4784th Air Base Group was deactivated and the 4789th Air Base Group (OLAC) was formed to act as a caretaker for the Air Force and to operate the base utility systems. Also at the time, the 102nd Fighter Interceptor Wing, Massachusetts Air National Guard, became the airfield manager.

For all practical purposes, Otis Air Force Base ceased to exist in late 1973 when the Air Force ended nearly all activity at the Base. A process was initiated to license the Massachusetts Air National Guard (MAANG) to operate and manage about 3230 acres of what previously had been Otis AFB, thereby creating Otis Air National Guard Base. Under requirements discussed elsewhere in this report, (MAANG) is now responsible for inventorying and evaluating environmental hazards associated with past hazardous waste disposal activities on its base. Otis ANG Base, the area investigated in this work, is represented by the shaded area in Figure 1 and elsewhere throughout the text. The balance of the 19,000-plus acres of the Otis/Edwards military reservation is licensed predominantly to the Army and Coast Guard.

Organization and Mission

The existing mission at Otis ANG Base is the Massachusetts Air National Guard (102 Fighter Interceptor Wing). It provides the Commander in Chief of the North American Air Defense Command (NORAD) with the required number of aircraft and aircrews on a 24 hour day, 365 days per year basis to maintain the air sovereignty of the United States in its assigned sector.

The ANG is also responsible as the airfield manager for operation and maintenance of the airfield. They equip, administer, train and furnish personnel in order to operate and maintain the installation facilities as required. They provide administrative and logistical support to units or agencies as specified in applicable support agreements.

CHAPTER 3

ENVIRONMENTAL SETTING

The migration of contaminants from a hazardous waste site is controlled largely by environmental factors including climate, geology, soils, hydrology, and topography. Data concerning the environmental setting at Otis Air National Guard Base are available from reports and maps produced by public agencies.

Climate

Climatological data, which were provided by the 102nd Fighter Interceptor Wing Weather Office, are shown in Table 3-1. Precipitation is distributed fairly uniformly throughout the year with an annual average of 47.8 inches for the indicated period of record. The temperature varied from -10 deg F to 99 deg F during the period of record, with an annual average of about 49 deg F.

Geology and Topography

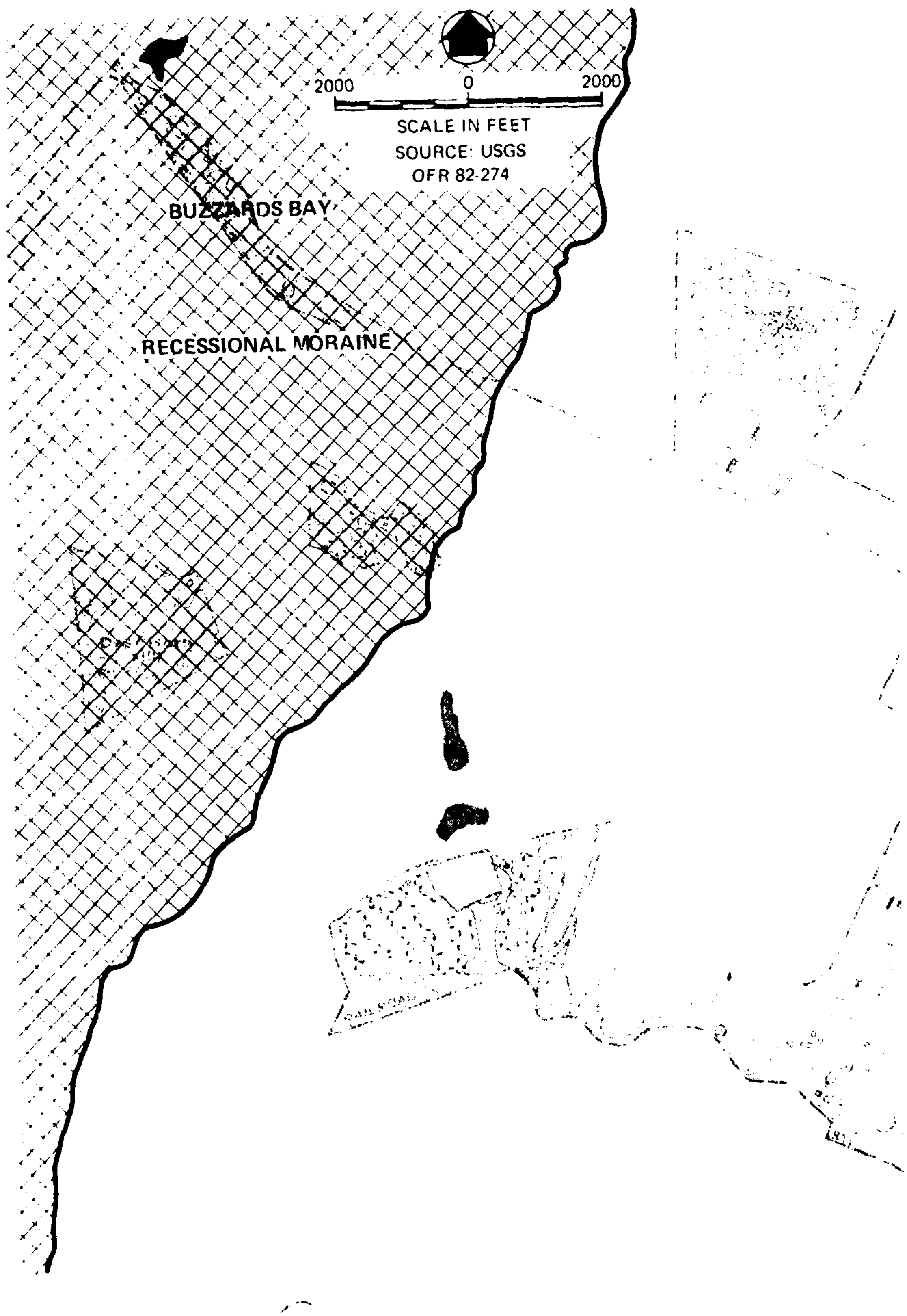
Geological data for the Otis ANG Base area are available from reports and maps published by the U.S. Geological Survey. Most of the Base is located on a broad outwash plain that was deposited during the retreat of the Pleistocene ice sheets from the area about 14,000 years ago (Figure 3-1). The outwash plain slopes gently to the south toward Nantucket Sound. The elevation of the outwash plain on the Base typically varies from 140 to 100 feet above mean sea level (msl), although lower elevations occur in swales and in closed depressions called kettle holes.

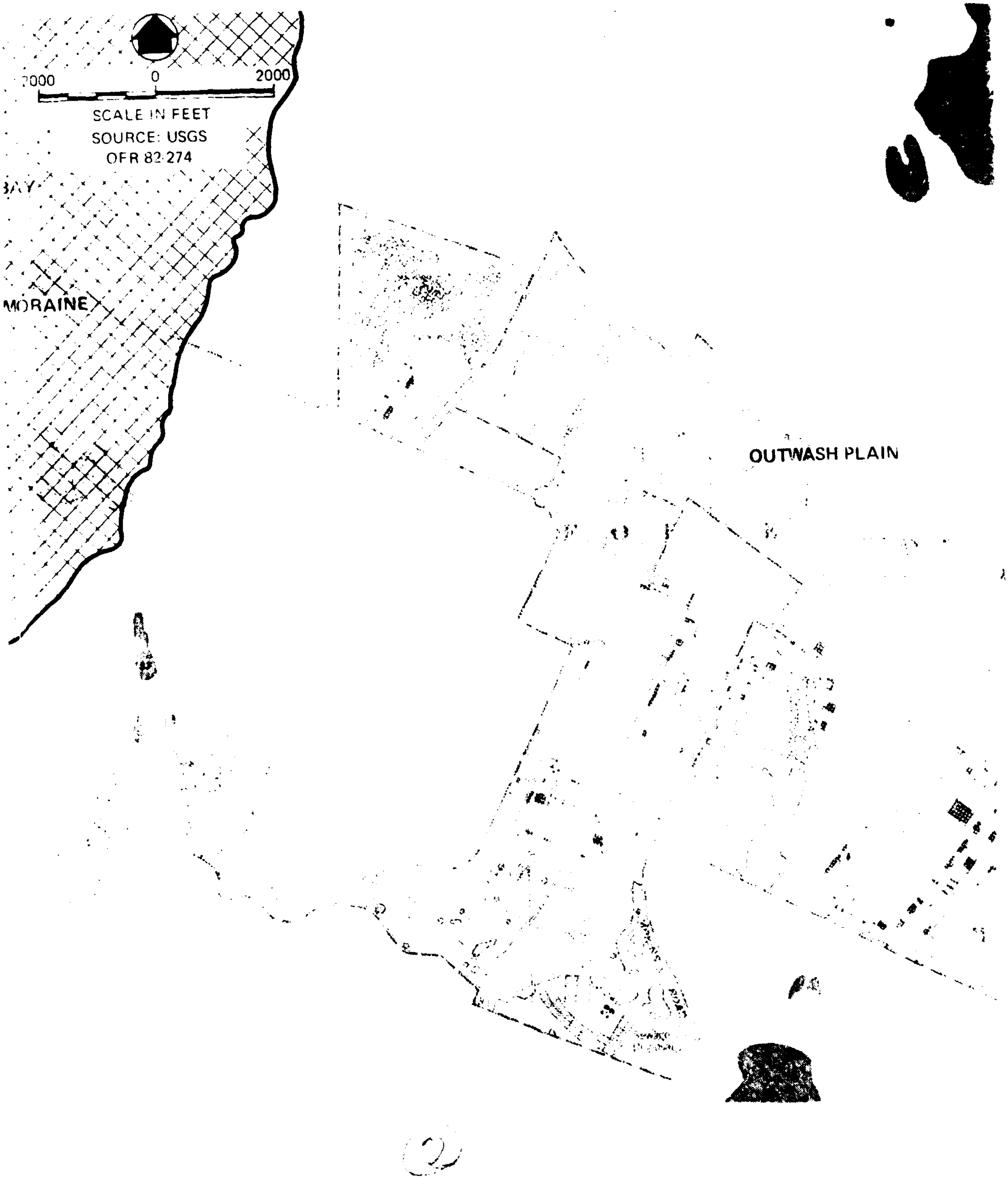
The westernmost portion of the Base along Connery Avenue is located in an area of hummocky terrain which represents the south-westerly extension of the Sandwich recessional moraine, sometimes

TABLE 3-1. CLIMATOLOGICAL DATA

Month	Temperature (F^{o}) Daily Max.	Temperature Mean Min.	Temperature Extreme Max.	Temperature Extreme Min.	Precipitation (in) Mean	Surface Winds Prevailing Direction	Surface Winds Mean Speed
Jan.	38	24	60	-7	4.8	NW	11
Feb.	38	23	59	-9	4.1	NW	11
Mar.	43	30	68	1	4.3	NW	12
Apr.	53	38	79	18	4.7	SW	11
May	64	47	86	28	3.4	SW	10
Jun.	73	57	97	41	2.0	SW	10
Jul.	78	63	96	47	3.3	SW	9
Aug.	77	62	99	44	4.8	SW	9
Sep.	70	55	89	36	3.9	SW	9
Oct.	62	46	82	22	3.7	SW	12
Nov.	52	37	74	15	4.5	NW	11
Dec.	41	27	65	-10	4.3	NW	12
Annual	57	42	99	-10	47.8	WSW	11

Source = 102nd FIW Weather Office
Period of Record = Oct. 42 - Apr. 44, Nov. 48 - Dec. 71


2000 0 2000
SCALE IN FEET
SOURCE: USGS
OFR 82-274
BUZZARDS BAY
RECESSIONAL MORAINE



2000 0 2000
SCALE IN FEET
SOURCE: USGS
OFR 82-274
MORAINE
OUTWASH PLAIN

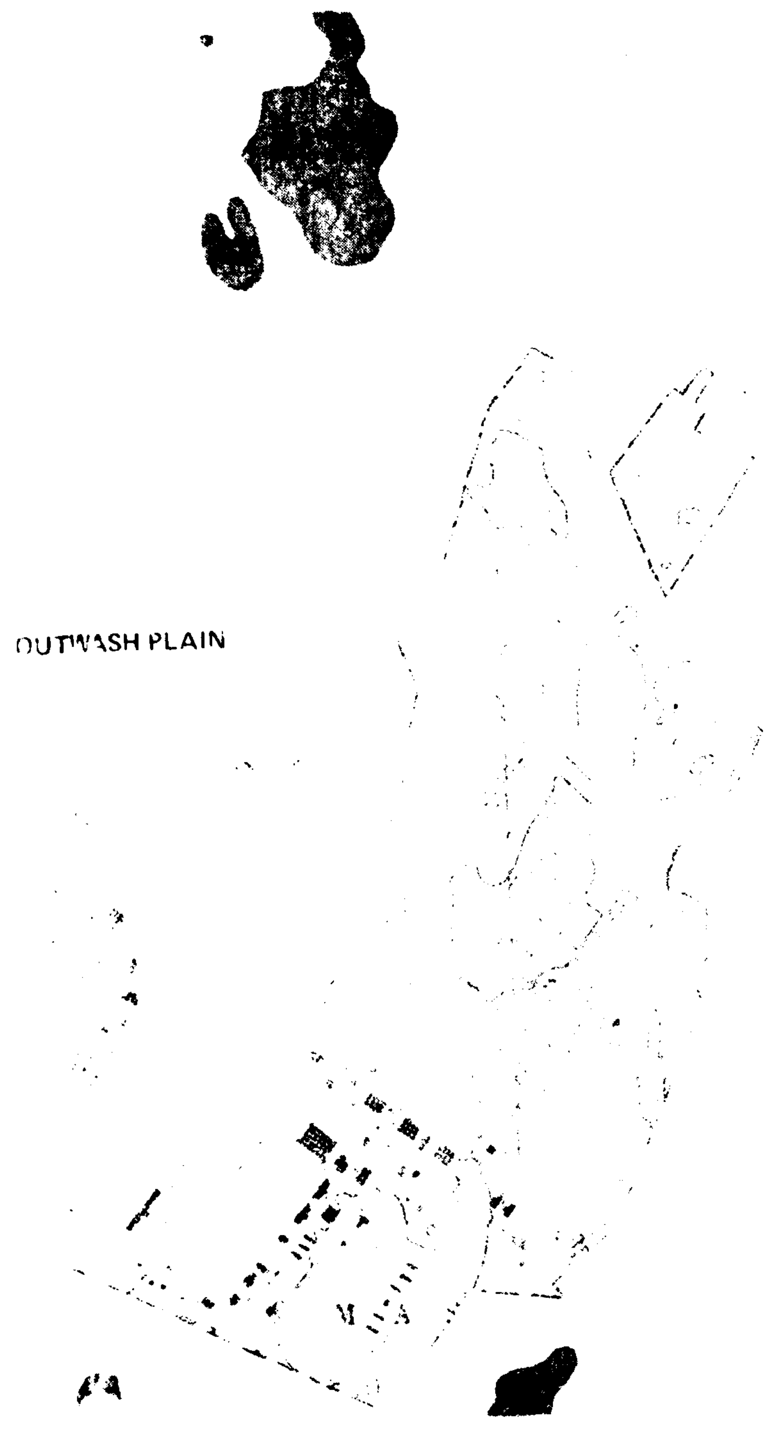


FIG. 3-1 GEOLOGY MAP-
OTIS ANG BASE VICINITY

(3)

called the Buzzards Bay moraine. This deposit was also formed during the retreat of the Pleistocene ice sheets from the area and typically ranges in elevation from 100 to 250 feet above msl in the vicinity of the Base property.

The unconsolidated glacial deposits are underlain by crystalline bedrock at an elevation of approximately 150 feet below msl.

Hydrology

The unconsolidated glacial deposits on Cape Cod constitute an aquifer which is a primary source of water supply. The aquifer has been designated a "sole source" by the U.S. EPA. Groundwater in the aquifer in the vicinity of Otis ANG Base occurs under water-table conditions. Figure 3-2 is a regional water-table map of western Cape Cod, while Figure 3-3 shows the general water-table configuration beneath the Base. The groundwater flow direction is perpendicular to the contour lines in a downgradient direction.

Data concerning the aquifer materials are available from a study by the U.S. Geological Survey entitled, "Sewage Plume in a Sand and Gravel Aquifer, Cape Cod, Massachusetts." Wells drilled as part of that study in the vicinity of the Base sanitary wastewater treatment plant revealed that the upper aquifer materials and the overlying unsaturated zone consist of well-sorted, brown, medium to very coarse sand with some gravel. These materials occur from the surface to an elevation of about 100 feet below msl. They are underlain by about 50 feet of fine to very fine sand and silt, which is in turn underlain by crystalline bedrock.

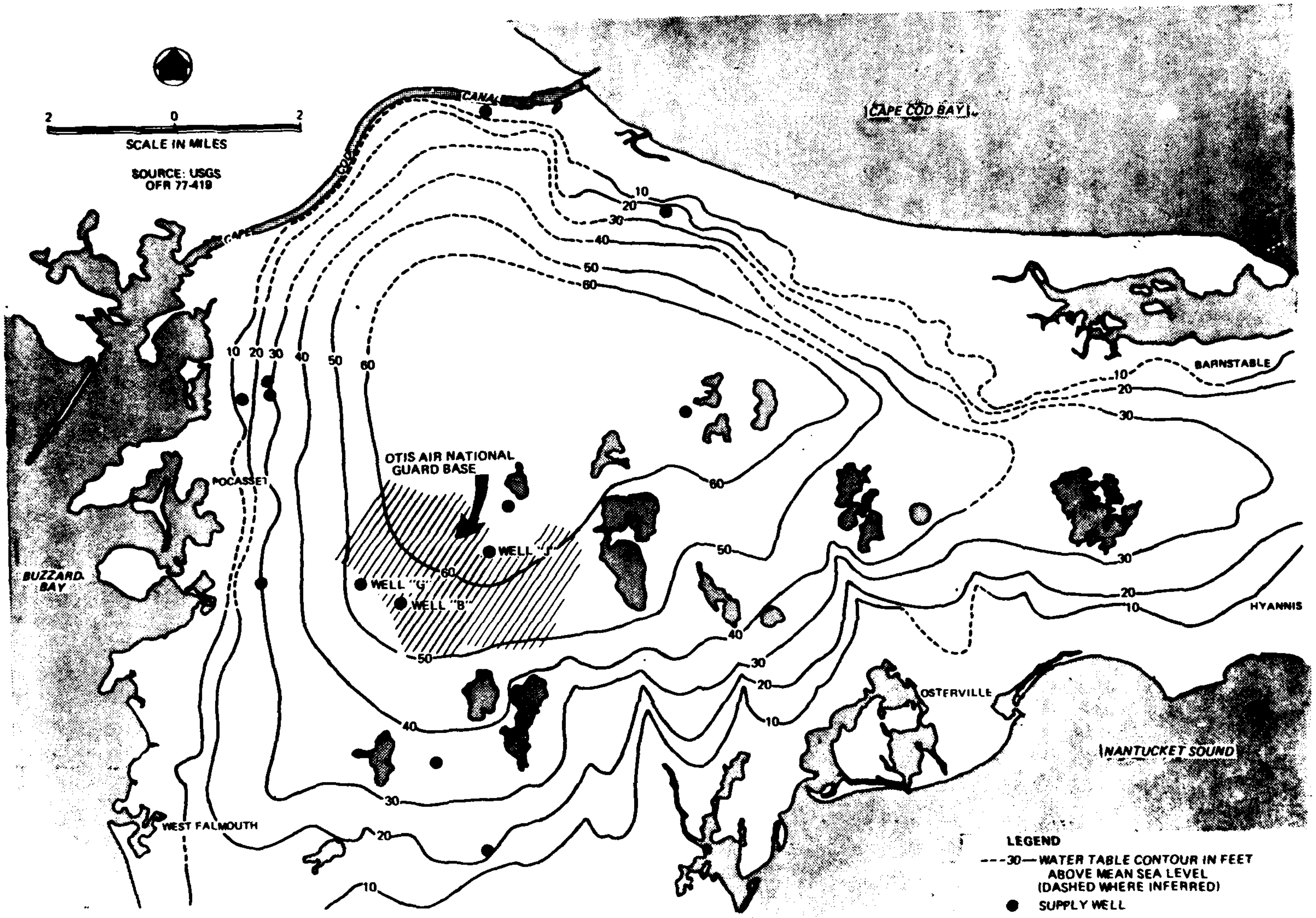
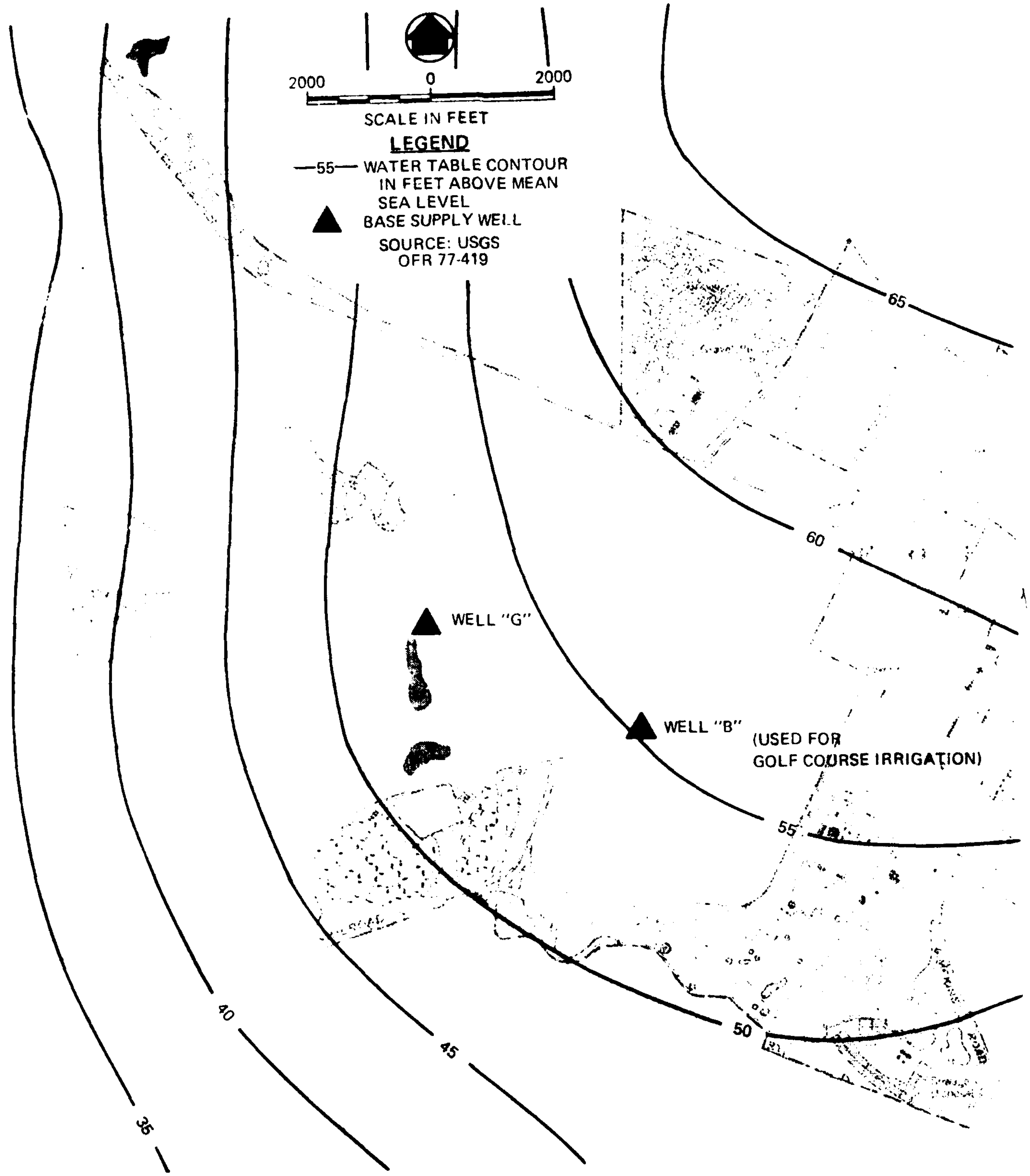
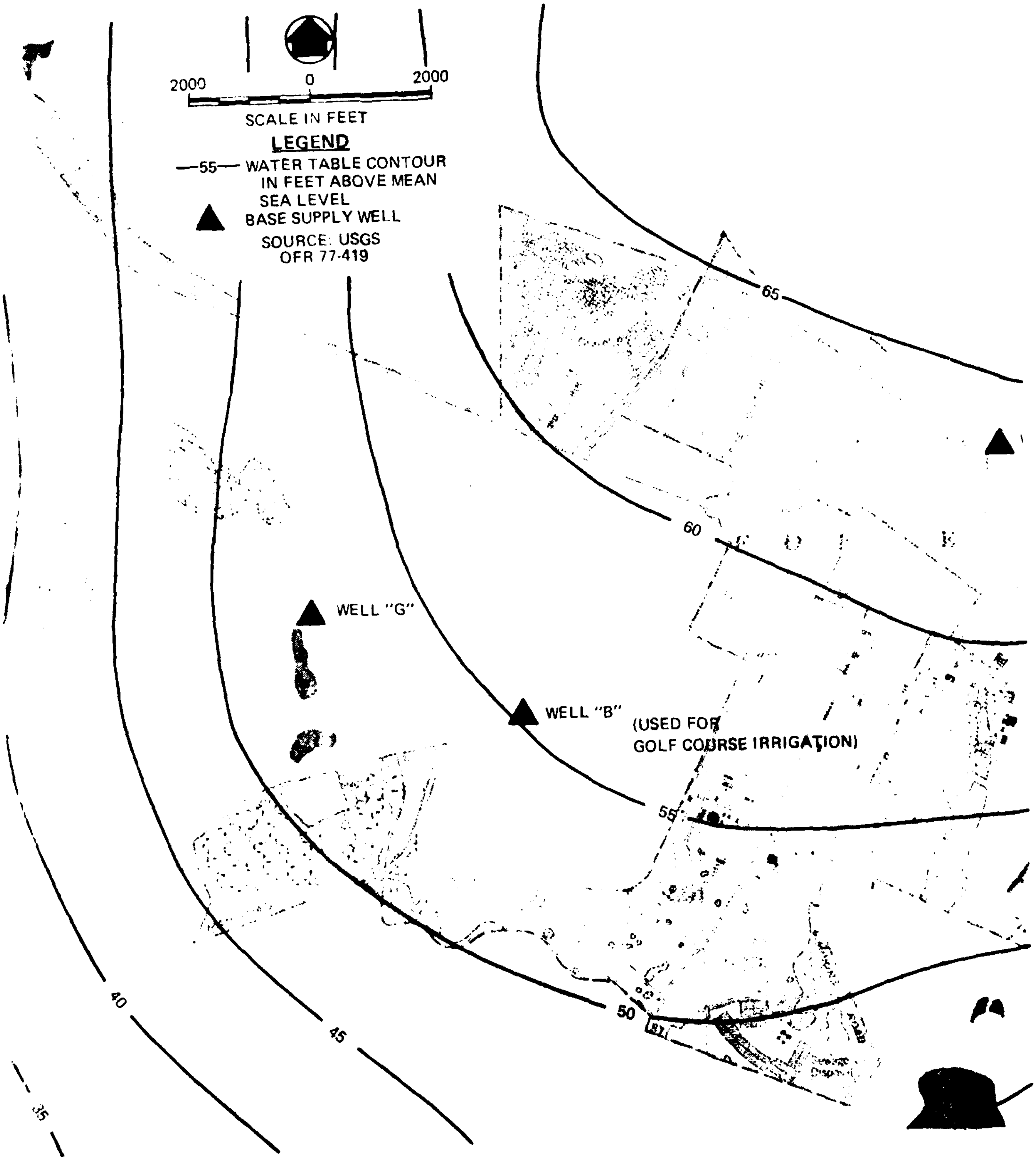


FIG. 3-2 REGIONAL WATER TABLE CONFIGURATION AND LOCATION OF WATER SUPPLY WELLS


2000
0
2000
SCALE IN FEET
LEGEND
—55— WATER TABLE CONTOUR IN FEET ABOVE MEAN SEA LEVEL
BASE SUPPLY WELL
SOURCE: USGS OFR 77-419
WELL "G"
WELL "B"
(USED FOR GOLF COURSE IRRIGATION)
65
60
55
50
45
40
35


2000
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SCALE IN FEET
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—55— WATER TABLE CONTOUR IN FEET ABOVE MEAN SEA LEVEL
BASE SUPPLY WELL
SOURCE: USGS OFR 77-419
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WELL "G"
WELL "B"
(USED FOR GOLF COURSE IRRIGATION)
55
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40
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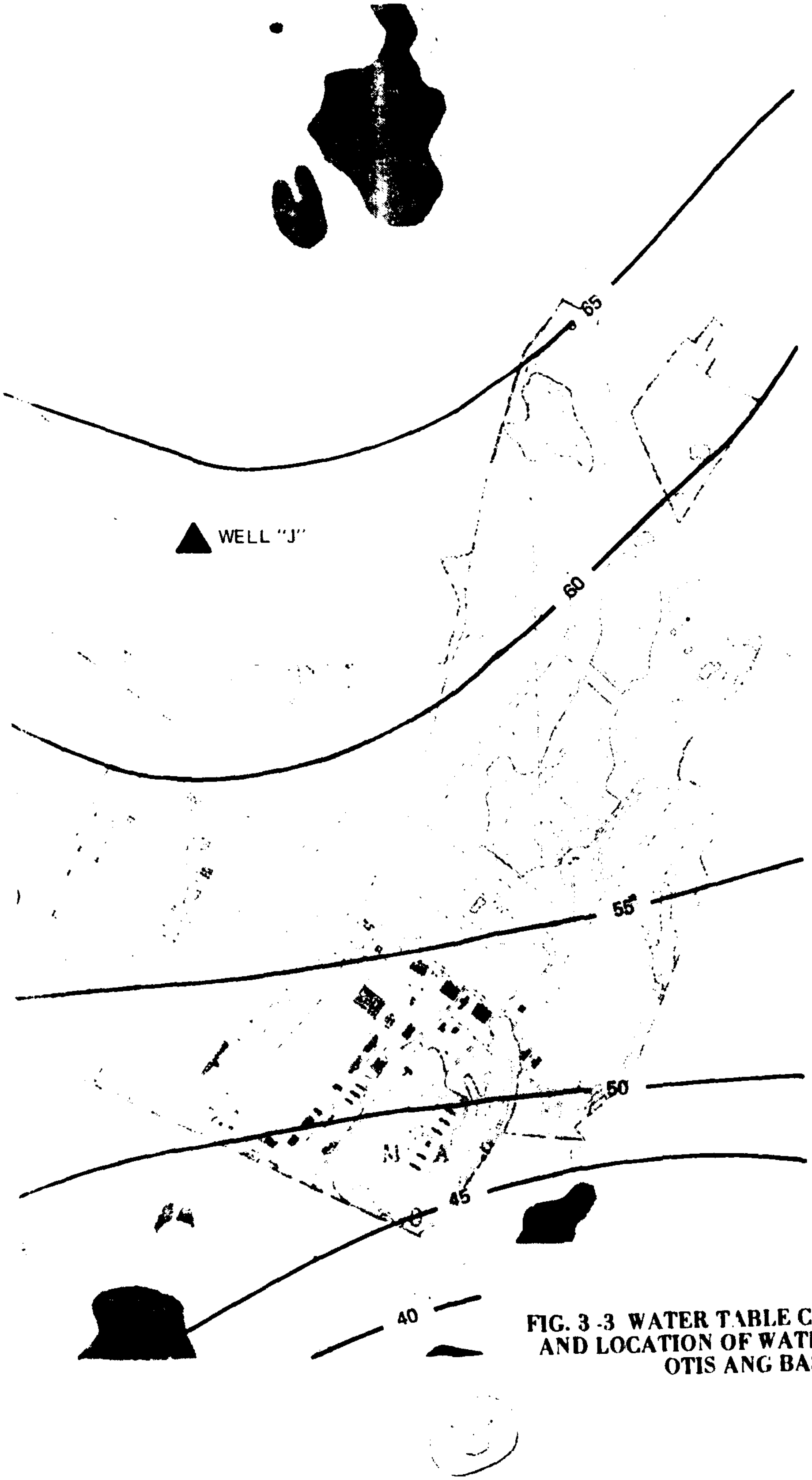


FIG. 3-3 WATER TABLE CONFIGURATION AND LOCATION OF WATER WELLS AT OTIS ANG BASE

The primary sources of groundwater recharge to that part of the aquifer underlying the Base are precipitation and inflow from adjacent parts of the aquifer. The recharge to the aquifer in the western part of Cape Cod is estimated by the U.S.G.S. (see Reference 39) to be 21 inches per year, slightly less than half of the annual precipitation. Almost all of the remaining precipitation is returned to the atmosphere by evaporation and transpiration by vegetation. Minor surface runoff to ponds or depressions occurs under certain conditions

Most of the groundwater flow beneath and in the vicinity of the Base occurs in the upper coarse materials of the aquifer. The horizontal hydraulic conductivity of these materials is estimated by the U.S.G.S. to be 200-300 feet per day, and the average groundwater flow velocity is estimated to be about one to two feet per day. The horizontal hydraulic conductivity is high due to the coarse textures and the original horizontal deposition by glacial streams. The vertical hydraulic conductivity is most likely lower than the horizontal, but it is probably also relatively high due to the coarse textures of the materials.

Soils

The U.S. Department of Agriculture, Soil Conservation Service prepared a soil map of the Base area in 1980. Most of the Base is underlain by soils of the Carver, Agawam, and Enfield series. These soils typically develop on glacial outwash plain deposits and are characterized by coarse textures and moderate to rapid permeabilities.

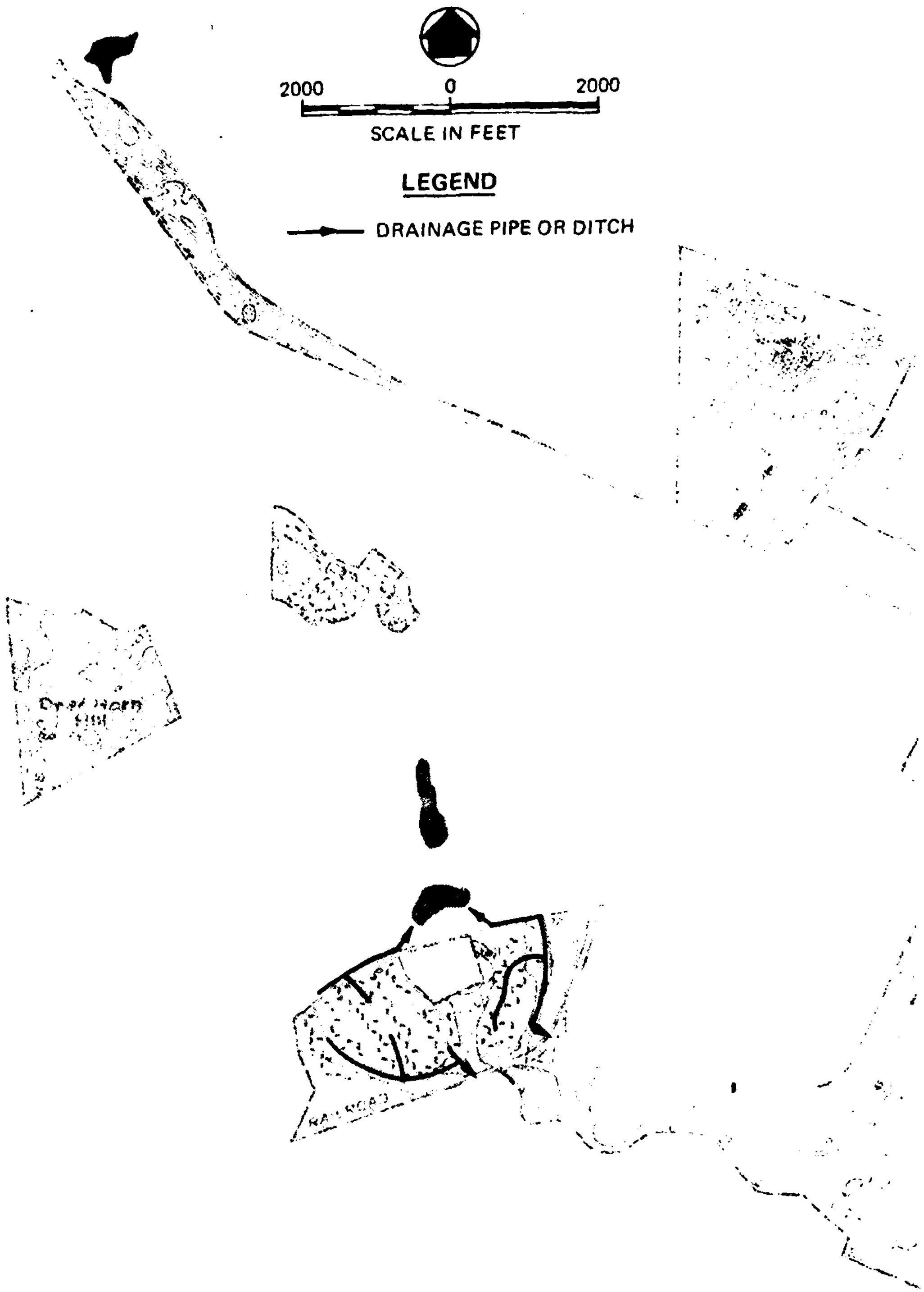
Surface Water and Drainage

No streams exist on Otis ANG Base. The subsurface materials are permeable and continuous, and drainage from the site under natural conditions is through the groundwater system to nearby streams or the ocean. The introduction of buildings and paved surfaces to the environment prevents infiltration of precipitation and concentrates the resulting surface runoff into a storm drain system.

The storm drains in the housing area in the western part of the Base consist of numerous small systems which terminate in ponds and depressions. The storm drains beneath the runways and flight line in the eastern part of the base consist of larger systems that discharge to three open drainage channels that direct the runoff off the Base. The two drainage channels that receive runoff from the most active flight line areas are equipped with oil/water separators, located at or near the Base boundary. One of the drainage channels continues 3,600 feet beyond its separator, where it terminates in Johns Pond (off-Base). Johns Pond is drained by the Childs River and the Quashnet River. The other drainage channel continues 2,200 feet beyond its separator to Ashumet Pond (off-Base), which has no outlet. The general pattern of drainage on the Base is shown in Figure 3-4.

Wat'r Supply

Prior to 1940 a well field consisting of numerous shallow, small-diameter wells was used to supply water for the National Guard installation at Camp Edwards. The expansion of the Base in 1940 included a groundwater exploration program to locate additional water supplies. Twelve pairs of small diameter test wells were drilled in depressions or swales at scattered locations



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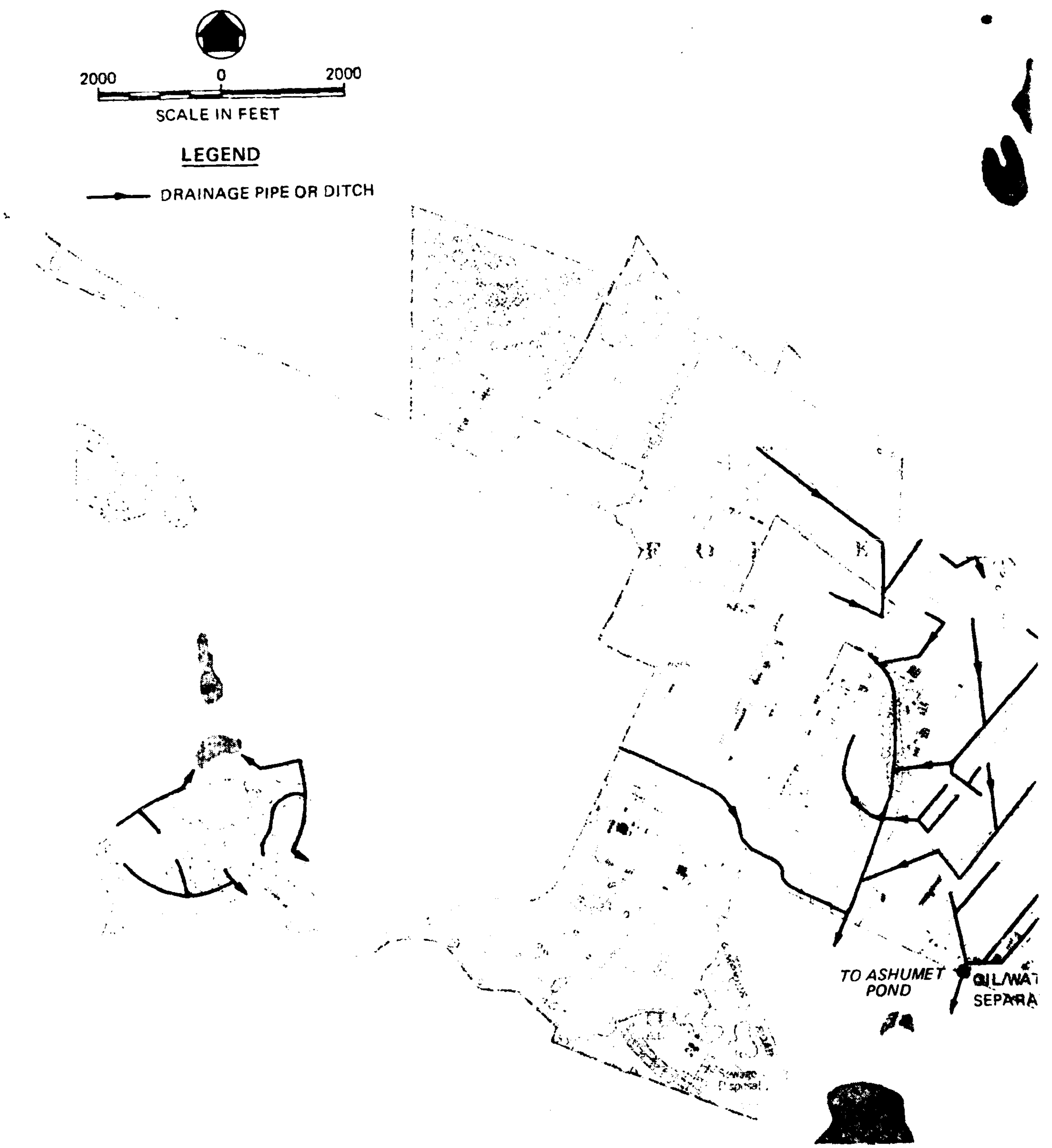

2000
0
2000
SCALE IN FEET
LEGEND
DRAINAGE PIPE OR DITCH
TO ASHUMET POND
OIL/WAT
SEPARA

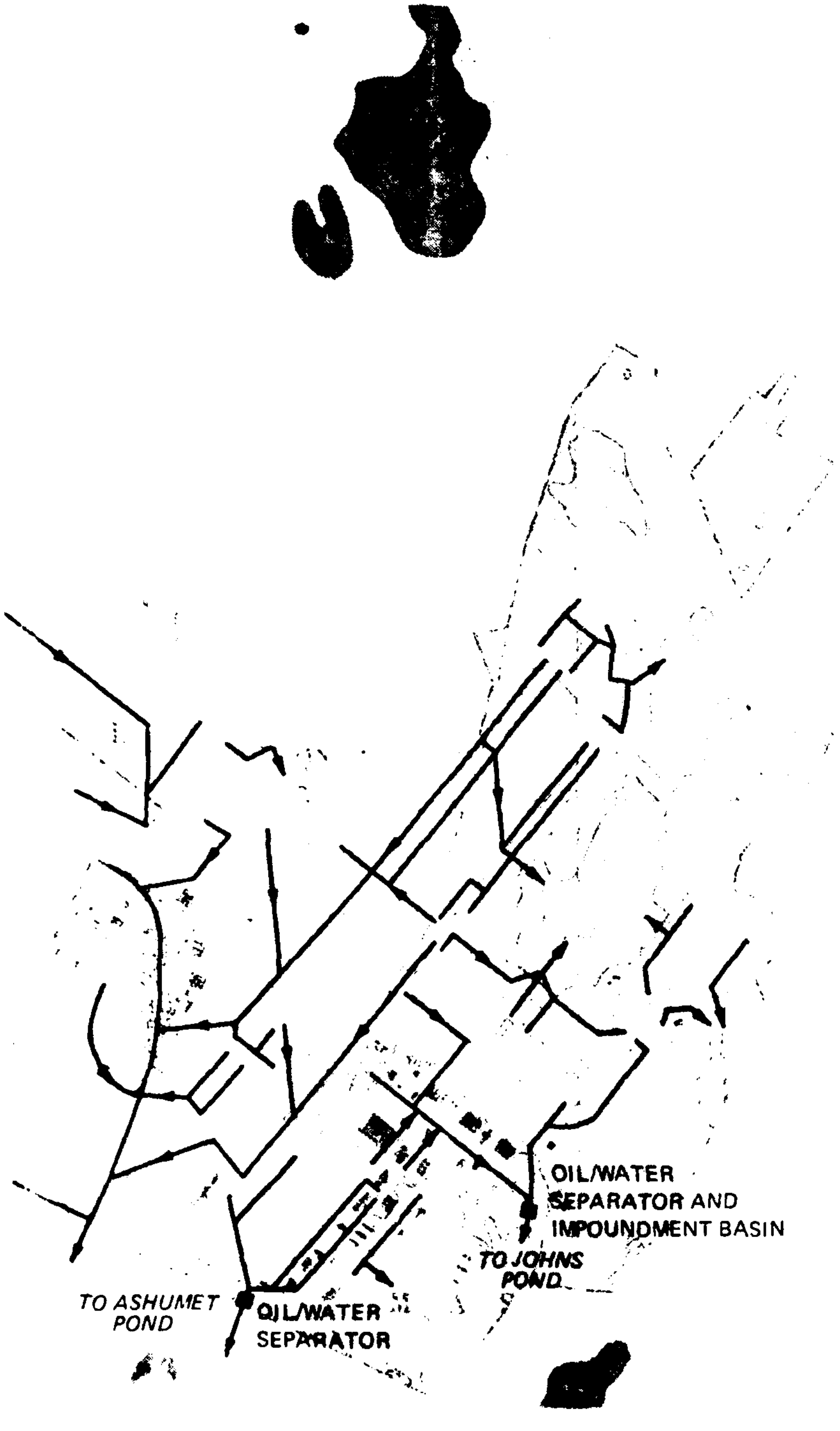


FIG. 3-4 SURFACE DRAINAGE

3

on the Base. Uniform sands with effective grain sizes of 0.2 to 0.32 mm were reportedly encountered in all the wells.

Four gravel-packed wells were constructed as a result of the exploration program and were designated by the letters GW-B, GW-E, GW-G, GW-J. The wells were all constructed with 24-inch diameter casing and 40 to 45 feet of 24-inch diameter shutter well screen. Table 3-2 shows data regarding the well elevations and depths.

TABLE 3-2. ELEVATION AND DEPTH DATA - ORIGINAL BASE SUPPLY WELLS

Well	Pump Station floor elev. (ft above msl)	Bottom of well elev. (ft below msl)	Depth of well (ft)	Static water level elev. (ft above msl)
B	61.5	-22.0	83.5	59
E	69.0	-16.0	85.0	64
G	61.5	-26.0	87.5	54
J	70.0	-16.0	86	64

The locations of GW-B, GW-G and GW-J are shown in Figure 3-2. GW-E was located in the same depression as GW-J. It is not shown in Figure 3-2 because it has been abandoned. Sometime after 1940, well GW-A was constructed adjacent to GW-B. No records were found regarding the construction details of well GW-A. It has also been abandoned. Well GW-B is used only to irrigate the Coast Guard golf course. Data regarding the water quality in supply wells GW-G and GW-J are included in Appendix C.

CHAPTER 4

FINDINGS

Hazardous materials have been introduced to the environment through typical past base activities and through the disposal of wastes generated by those activities.

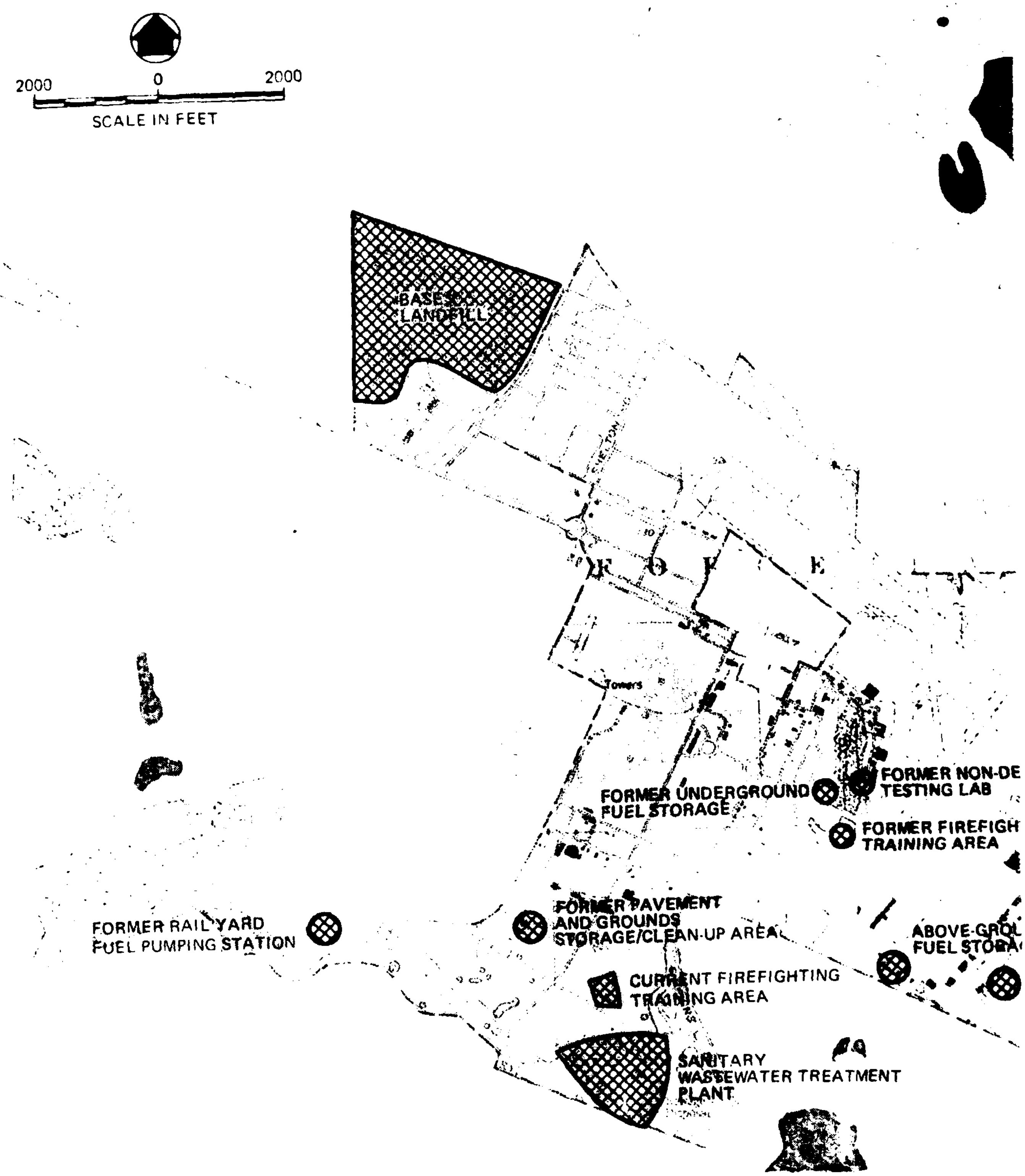
Past Activity Review

Base activities that resulted in the generation and disposal of hazardous and non-hazardous waste, or in the unintentional release of hazardous materials, were identified by reviewing files and records, interviewing current and former employees, and conducting site inspections. Figure 4-1 shows the sites that were considered during this study.

Hazardous wastes are defined for the purposes of this report as those wastes identified in 310 CMR 30.000 (Code of Massachusetts Regulations), effective July 1, 1982, Hazardous Waste Regulations, promulgated by the Commissioner of the Department of Environmental Quality Engineering. The regulations provide the following general statutory definition of hazardous waste:

> A hazardous waste is a waste, or combination of wastes, which because of its quantity, concentration, or physical chemical or infectious characteristics may cause, or significantly contribute to, an increase in mortality


2000 0 2000
SCALE IN FEET
BASE LANDFILL
FORMER RAIL YARD
FUEL PUMPING STATION



2000
0
2000
SCALE IN FEET
BASE LANDFILL
Towers
FORMER NON-DE
TESTING LAB
FORMER UNDERGROUND
FUEL STORAGE
FORMER FIREFIGH
TRAINING AREA
FORMER RAIL YARD
FUEL PUMPING STATION
FORMER PAVEMENT
AND GROUNDS
STORAGE/CLEAN-UP AREA
ABOVE-GROU
FUEL STORA
CURRENT FIREFIGHTING
TRAINING AREA
SANITARY
WASTEWATER TREATMENT
PLANT

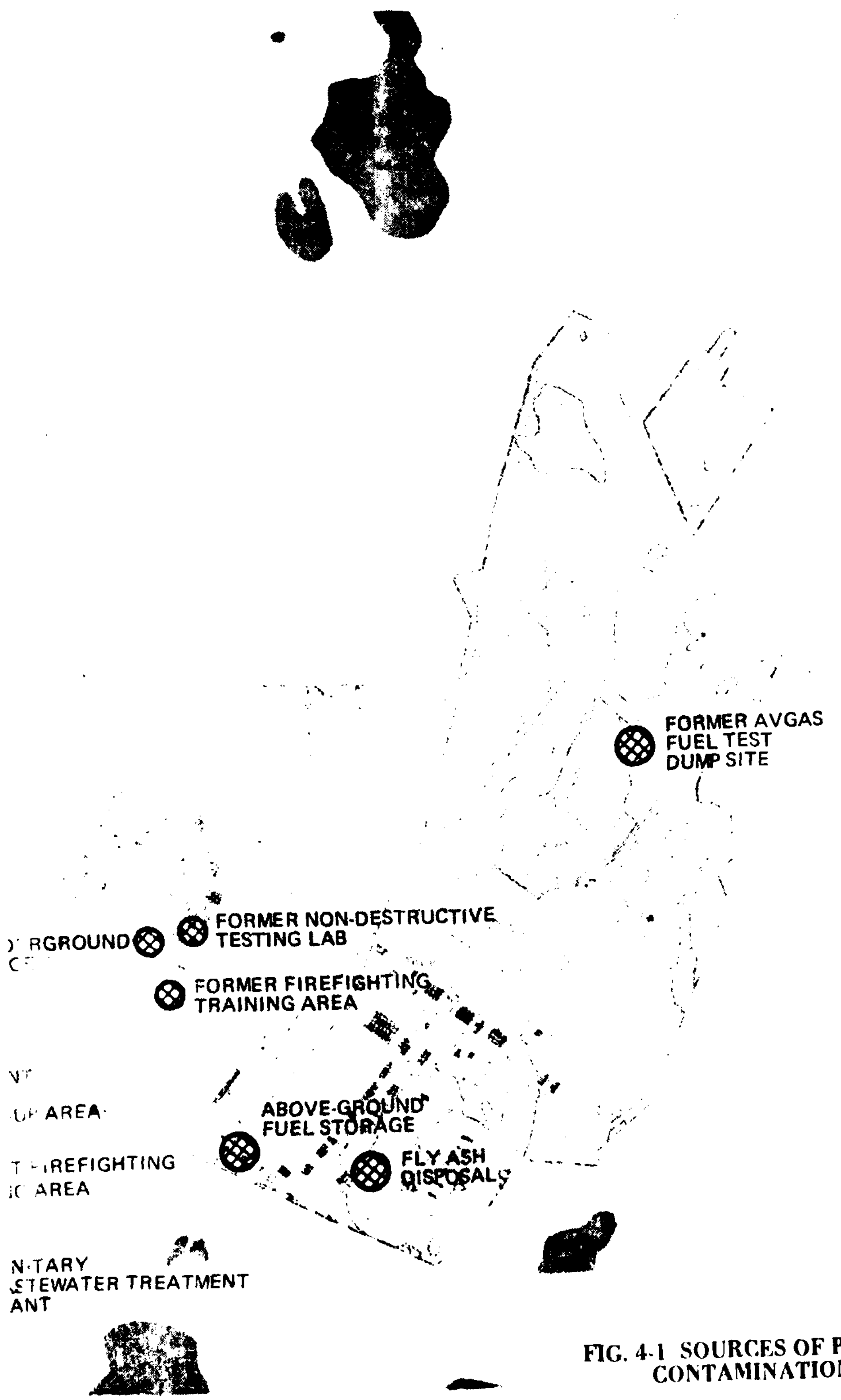


FIG. 4-1 SOURCES OF POTENTIAL CONTAMINATION

or an increase in serious irreversible, or incapacitating reversible, illness, or pose a substantial present or potential hazard to human health, safety, or welfare, or to the environment, when improperly stored, treated, transported, or disposed of, or otherwise managed.

More specifically, the regulations identify characteristics of hazardous waste and the tests to determine them; specific types and sources of hazardous and acutely hazardous wastes; and specific wastes which are listed as hazardous or acutely hazardous. One significant difference between the Massachusetts regulations and the U.S. EPA regulations is that waste oils are listed as hazardous waste in the Massachusetts regulations. The Base activities that have accounted for most of the handling of hazardous materials are:

1. Aircraft Maintenance and Operations and Base Civil Engineering Functions
2. Firefighting Training
3. Fuels Management
4. Other activities

Data regarding activities were obtained largely from interviews, since written records are limited. Shop files, which are maintained by the 102nd USAF Clinic in Building 169, were examined but did not contain data relevant to past disposal practices.

<u>Aircraft Maintenance and Operations and Base Civil Engineering Functions</u>. The activities and shops associated with aircraft maintenance and operations and civil engineering

functions include battery shops, non-destructive testing labs, an aircraft washrack, fuel testing labs, motor pools, electrical shops, paint shops, pavement (roads) and grounds, the sanitary wastewater treatment plant, and the landfill.

Most of these shops or facilities have been located at different sites on the Base during different time periods. The flight line facilities were moved during the early 1970's from the west side of Runway 05/23 to the east side, an area that was previously occupied by the active Air Force. Information obtained during the interviews indicates that hazardous wastes that were generated by the shops were either disposed of in the landfill, used for firefighting training exercises, or removed by service contracts with Base civil engineering or the Defense Property Disposal Office (DPDO). Small quantities of hazardous wastes may have been disposed of in drains leading to storm drains or sanitary sewers. In the case of the non-destructive testing lab in the old flight line area west of runway 05/23, liquid wastes were disposed of in an on-site disposal system which is discussed in greater detail in the description of past on-site disposal practices.

Firefighting Training. Firefighting training activities have been conducted primarily at two locations on the Base according to information collected during the interviews. From about 1958 to the present, firefighting training has been conducted at the site shown in Figure 4-2. Currently jet fuel (JP-4) is used for training, and a concrete pad is being constructed to prevent infiltration of the fuel and firefighting

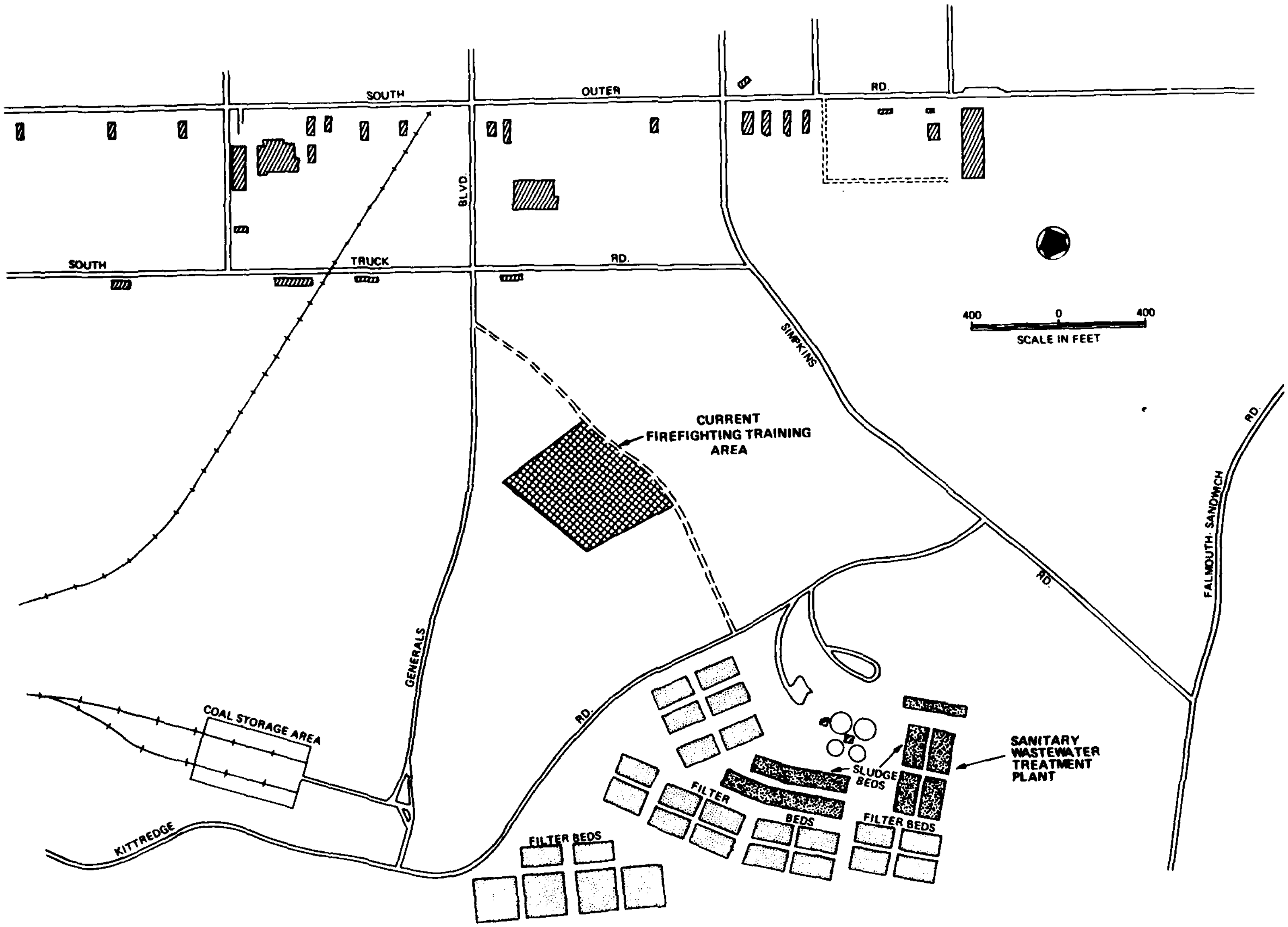


FIG. 4-2 CURRENT FIREFIGHTING TRAINING AREA

chemicals. Firefighter training is conducted quarterly. In recent years, approximately 7,000 to 10,000 gallons of jet fuel have been allocated annually. Eight days of training per quarter are typical, with either about 50 or 300 gallons of fuel used for each burn. Base firefighting personnel estimate that 70 percent of the fuel is consumed in the fires.

The current firefighting training area was unlined in the past. Fires were created by burning primarily fuel or waste oil, although waste materials from drums were also used. Hundreds of drums were reportedly disposed at the site, including two drums of transformer oil and unknown quantities of solvents, paint thinner, and hydraulic fluid. After the materials had been ignited and extinguished with water and/or foam, the residual mixture would evaporate or infiltrate the permeable sand and gravel soil in the area. Monthly firefighting training was required for Base firemen until the 1970's, when the frequency was reduced first to quarterly and then to semi-annually. Additionally, training exercises were conducted for off-Base firemen during the summer months.

A shallow well was installed several hundred feet down-gradient of the current firefighting training area to supply water for a field laboratory for personnel of Woods Hole Oceanographic Institute during the 1974-1978 spray irrigation study. The well was never used since it reportedly yielded water with a hydro-carbon odor. Water quality data from the well are not available.

Water quality data are available from wells located about 1,500 to 10,000 feet downgradient from the site. The wells were analyzed for volatile organic chemicals by the Commonwealth of Massachusetts, and the results are shown in Appendix D. The wells contain chemicals that are listed hazardous wastes, although the concentrations are lower than the U.S. EPA existing and proposed Suggested No Adverse Response Levels (SNARLS). The current firefighting training area is a possible source of these chemicals, although other sources may exist south of the Base. A detailed study would have to be conducted before the source or sources of the organics could be determined.

A different firefighting training area was used prior to the development of the current site. The former site is shown in Figure 4-1. The firefighting training exercises at this site were also conducted primarily with waste oils and contaminated fuels. Lesser amounts of various flammable wastes in drums were reportedly burned at this site. The site was rated using the HARM system. Although the exact period of use for the site is not known, it probably included six to eight years. Moderate to large quantities of flammable materials would have been burned at the site during that time span.

A third firefighting training site was identified during one interview. The site was used for a brief period of time after the former site was abandoned but before the current site was developed. Its location near the fly ash disposal area led to its infrequent use and quick abandonment, since the smoke interfered with flight operations. The site was thus not rated.

Fuels Management. Fuels management has changed dramatically as different military organizations have occupied the Base.

During the Army period (1940-1952), the central quadrangle was ringed by motorpools which had underground fuel tanks for mogas storage and distribution. Most of these tanks were abandoned in place before 1968 and are reportedly empty.

During the Air Force period (1952-1974), several developments occurred regarding fuels management. An "aqua farm" fuel storage system, referred to as former underground fuel storage in Figure 4-1, was installed in the old flight line area west of Runway 05/23. The system was operated by using water to displace the fuel and pump it from the underground tanks. The underground aqua farm fuel storage system was later replaced by above-ground storage tanks at the location shown in Figure 4-1.

Fuel was delivered to these above-ground tanks through a pipeline that originated at a pump station near the rail spur at the southern edge of the Base (Figure 4-1). Large quantities of fuel were moved through this pump station during the summers of the most active Air Force years (1959-1961), and large quantities of fuel were reportedly spilled in the rail beds. Each time one of the large diameter hoses used to carry fuel from the tank cars was disconnected, several gallons of fuel were spilled from the hose. About 15-20 tank cars of fuel per day were unloaded during the period of peak usage. The ground was reportedly saturated with fuel at times. As much as 10,000 gallons of avgas and JP-4 may have been spilled at this site during its period of use (1959-1965). The fuel would have either evaporated or seeped into the groundwater system.

No large single fuel spills at Otis were recalled by the people interviewed. One person who was interviewed mentioned spills of unknown volume in the vicinity of the above-ground storage tanks, but these events were not recalled by others. Small quantities of JP-4 are wasted to the ground or to dry wells at the main POL storage area. The fuel/water discharge results from sump-draining the above-ground tanks and from pump house floor drains. These sites, which are located at or near the above-ground fuel storage facilities shown on Figure 4-1, were not rated with the HARM system since the quantity of waste is less than one gallon per month. A program has been initiated to stop these discharges.

Sludges that were removed from the avgas, JP-4, and mogas storage tank bottoms were disposed of in the landfill. The sludges were typically "weathered" prior to the landfilling, which means that they were spread on the ground for a period of time to allow the volatile sludge components to evaporate.

Other Activities. Herbicides and pesticides were used in limited quantities. Waste from pesticide operations was reportedly delivered to the salvage yard for sale or disposed of at the landfill. Herbicide wastes reportedly went to the landfill. Small quantities of herbicide residual may have entered the environment at the former Pavement and Grounds clean-up/storage area, but the amounts would not have been significantly different from the amounts applied during normal herbicide applications in designated areas.

Paving operations are conducted by Pavement and Grounds personnel. The truck beds and tools were washed with three to four gallons of diesel fuel to clean them at the end of each paving day, of which there are typically 20 per year. When Pavements and

Grounds was located behind Bldg. 971, the cleaning was done in the storage area shown in Figure 4-1. The cleaning is now done in a bunker located near the current location of Pavement and Grounds (Bldg. 124). Both sites were inspected. Neither site was rated, based on observations at the current site that the amount of fuel penetrating the soil is negligible.

A fuel dump valve testing site was used during the period when C-121 (Constellations) aircraft were based at Otis (Figure 4-1). The site consisted of a paved aircraft parking area surrounded on three sides by an embankment of existing sandy and gravelly soils. The Constellations were towed to the site and backed into the revetment. Six manually-operated fuel dumping valves were then opened for testing. An estimated 100 to 500 gallons of avgas were dumped during each aircraft test, and tests were conducted 2-3 times per week during the late 1960's and early 1970's. The firefighting crew that witnessed the testing would wash the avgas into the soils around the pavement, so that fuel vapors would not be present when the towing vehicle returned to remove the aircraft. As the aircraft aged and the required frequency of testing increased, a system was developed in which plugs were used to limit the quantity of fuel dumped. Also, barrels were used to catch the fuel. Nonetheless, up to 50,000 gallons of avgas could have been dumped in a five-year period, although this is just an estimate. The dumped fuel would either have entered the permeable soils directly or evaporated.

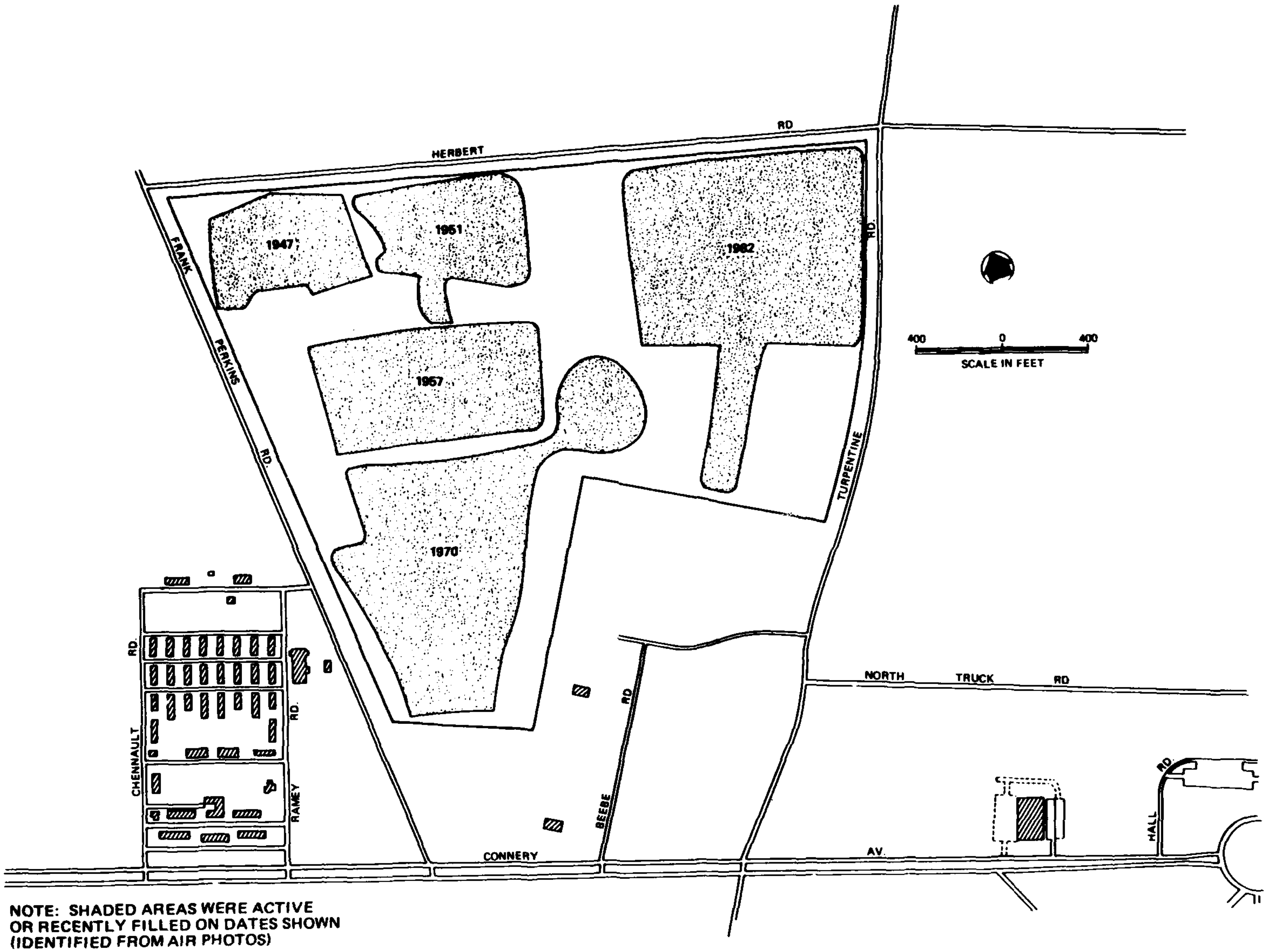
Description of Past On-Site Disposal Practices

The designated on-site facilities that have been involved in the disposal of hazardous and non-hazardous waste are the:

1. Base landfill.
2. Sanitary wastewater treatment plant.
3. Storm sewer system.
4. Fly ash disposal area.
5. Non-destructive testing lab (on-site disposal system).

Base Landfill. The Base landfill area includes about 100 acres and has been used for waste disposal since about 1940 (Figure 4-3). The ANG assumed responsibility for operation of the landfill on October 1, 1980 and placed restrictions on the types of wastes that could be accepted. Prior to that date, all types of waste were dumped. The landfill had unrestricted access for many years, and materials were often dumped when no one representing the Base was present. Access is now limited. A guard is located at the access road (off Herbert Rd.) to inspect all loads who is instructed to reject known or suspected hazardous waste.

Waste materials reportedly dumped into the landfill during its 40+ years of operation include general refuse, fuel tank sludges, herbicides, solvents, transformer oil, fire extinguisher fluids, blank small arms ammunition, paints, batteries, DDT powder, and hospital materials. This information was obtained during interviews, since no written records exist. Approximately 60 to 70 acres of the site have been filled with wastes to varying depths. The present operation consists of a series of trenches in which refuse is dumped and then covered daily with excavated material. The trenches are about 30 feet deep, 50 feet wide, and



NOTE: SHADED AREAS WERE ACTIVE
OR RECENTLY FILLED ON DATES SHOWN
(IDENTIFIED FROM AIR PHOTOS)

FIG. 4-3 LANDFILL SITE

500 feet long. Past landfilling methods were presumably similar. An inspection of the site revealed that the older landfill areas were covered with on-site sand and gravel. Vegetation is growing on much of the older area, although barren sections do exist that are reportedly the result of the dumping of aviation gas.

Surface elevations at the landfill are about 140 feet above msl. The water-table is at a depth of 80-85 feet below the surface. No monitoring wells have been constructed in the vicinity of the landfill. Therefore, neither geologic nor water quality data are available for a site-specific analysis of the potential for contaminant migration. However, geologic data from the drilling of the Base supply wells (about one mile from the landfill) and from the USGS monitoring well drilling at the sanitary wastewater treatment plant (about 2 miles from the landfill) indicate that impermeable soil materials probably do not occur between the base of the landfill (elevation 110 feet above msl) and the water table (elevation 60 feet above msl).

The nearest well downgradient of the landfill is Well GW-G, which is about 6,000 feet away. Water quality data for Well GW-G are included in Appendix E. The well was first tested for the presence of volatile organic chemicals in June, 1979, at which time trichloroethylene and tetrachloroethylene were detected. Numerous analyses have been conducted during the past three years. The latest analyses indicate that volatile organic chemicals are still present in the well discharge. The levels have never exceeded the SNARLS, however, and have generally exhibited a decreasing trend. The landfill is a possible source for the volatile organic chemicals in Well GW-G, although conclusive evidence is not available.

Sanitary Wastewater Treatment Plant. The sanitary wastewater treatment plant has provided secondary treatment for Base sewage since 1936 (Figure 4-2). The effluent is discharged to sand beds, where it infiltrates the ground and moves downward to the water table. Data regarding the movement of effluent in the groundwater system have been gathered and published by the U.S. Geological Survey (LeBlanc, 1982). Their study indicates that the years of disposal have caused a plume in the groundwater system that is 2,500 to 3,500 feet wide and extends at least 11,000 feet off-Base in a southerly direction. No evidence was gathered during the records search or interviews indicating that hazardous wastes were disposed of through the treatment plant. Therefore, it was not rated with the HARM system.

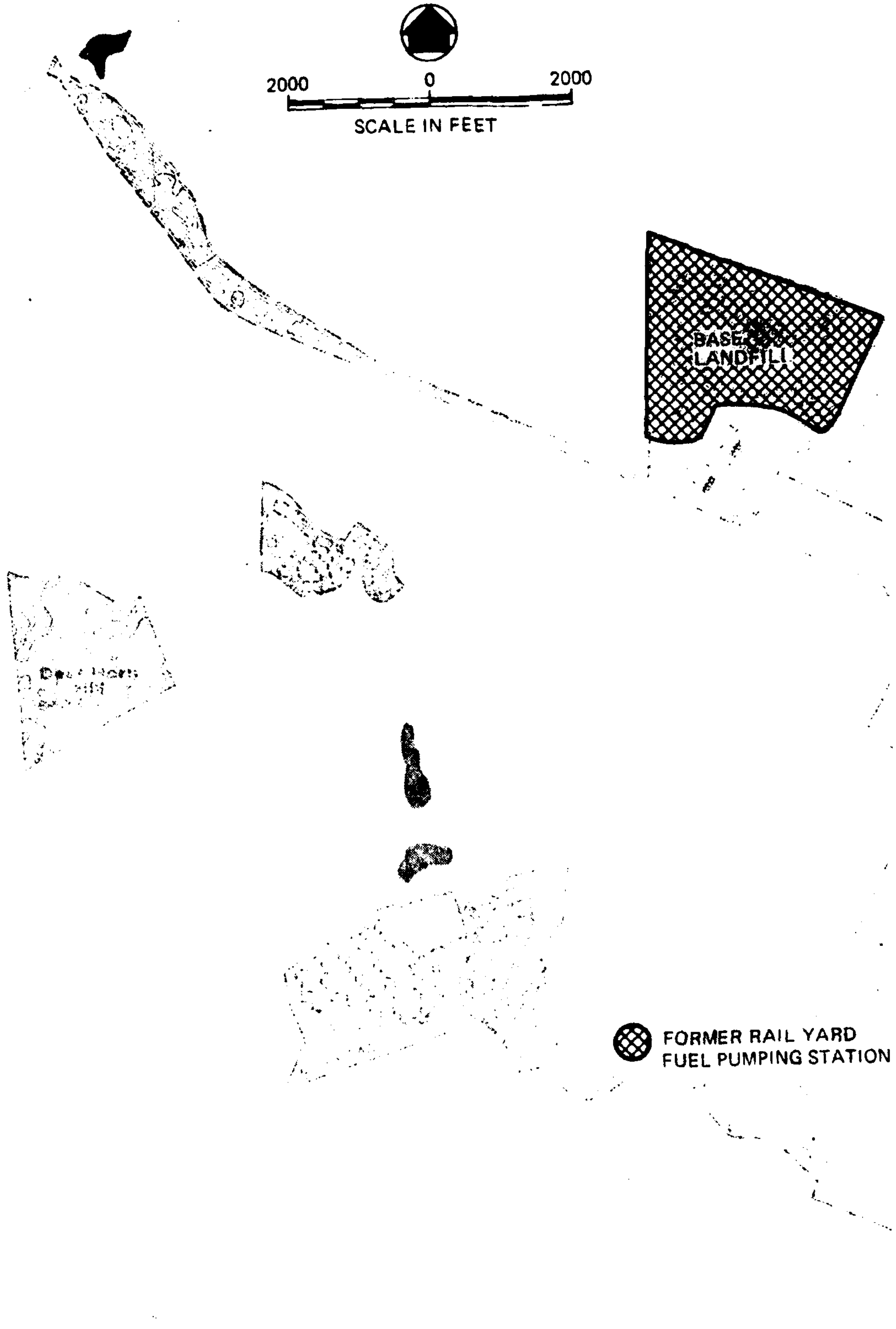
Storm Sewer System. Oil/water separators were installed in 1969 in two of the drainage swales that receive runoff from the flight line areas. The separators were constructed to prevent the off-Base movement of contaminants to a cranberry bog located adjacent to Ashumet Pond. They were cleaned out annually until 1982, when the practice was discontinued because consistently negligible volumes of oily waste accumulated in the separators in recent years.

Fly Ash Disposal Area. Otis ANG Base operations include a coal-fired heating plant. The fly ash from the plant emission control system is dumped just south of the plant, at the location shown in Figure 4-1. Fly ash is not subject to hazardous waste regulations.

Non-Destructive Testing Lab. The former non-destructive testing lab in Building 3146 had an on-site disposal system which consisted of a leaching pit. Trichloroethylene and other halogenated solvents were reportedly disposed of in unknown but substantial quantities through this system. Penetrants, emulsifiers, and developers were also probably disposed of in the same fashion.

Evaluation of Facilities and Disposal Practices.

The review of past operation and maintenance functions and waste disposal practices at Otis has resulted in the identification of six sites which were associated with hazardous materials and have the potential for migration of contaminants (Figure 4-4). Data concerning the sites are summarized in Table 4-1. The six sites were assessed using the Hazardous Assessment Rating Methodology (HARM) developed for the Installation Restoration Program. The HARM includes factors concerning potential receptors of contamination, waste characteristics, pathways for migration, and waste management practices. The details of the HARM are shown in Appendix B, and the results of the assessments are shown in Table 4-2. The actual rating forms for the six sites are shown in Appendix E, while Appendix F contains photographs of two of the sites.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SCALE IN FEET
BASE
LANDFILL
FORMER RAIL YARD
FUEL PUMPING STATION

2000
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2000
SCALE IN FEET
BASE LANDFILL
FORMER NON
TESTING LAB
FORMER FIREFI
TRAINING AREA
FORMER RAIL YARD
FUEL PUMPING STATION
CURRENT FIREFIGHTING
TRAINING AREA

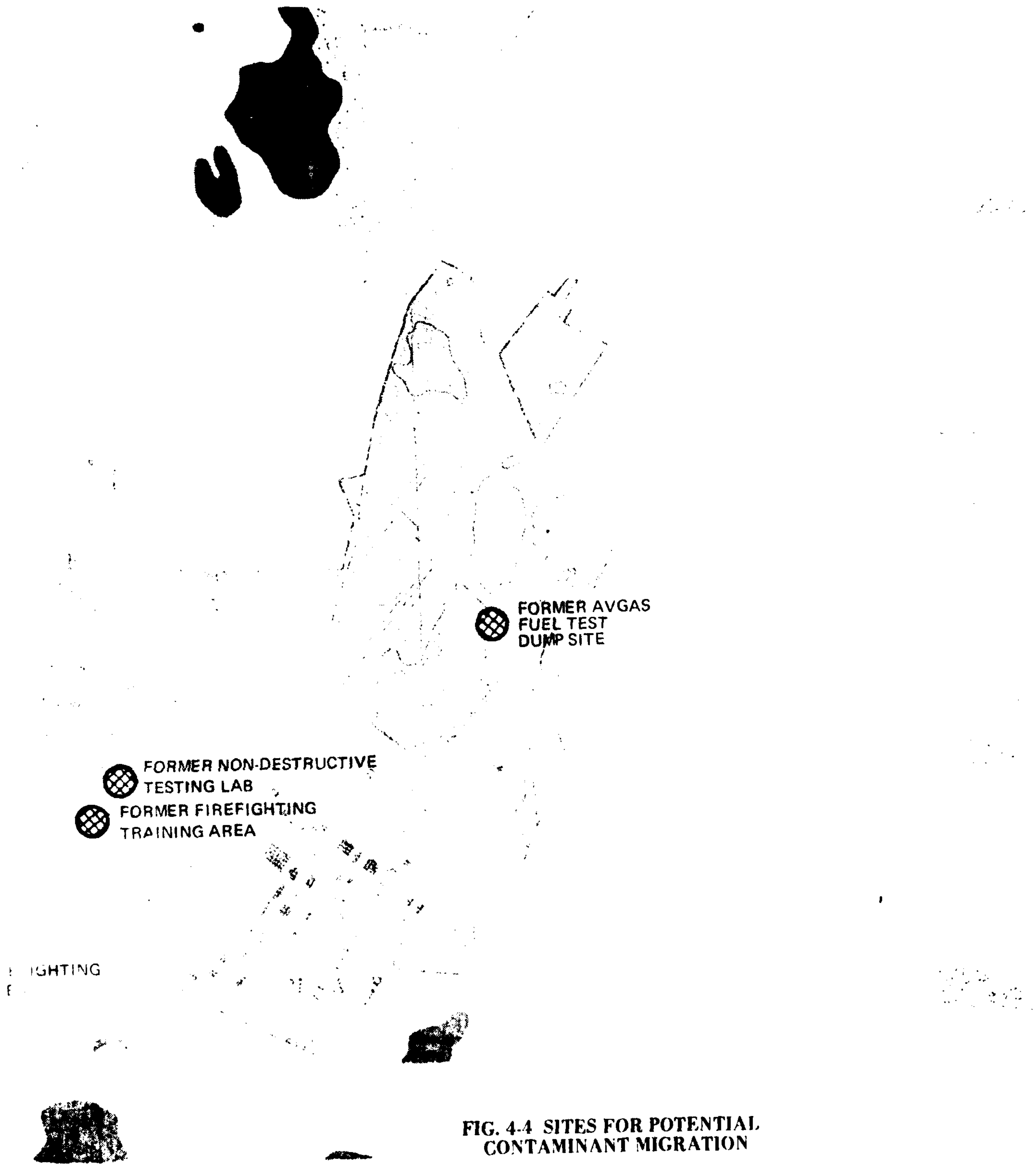


FIG. 4-4 SITES FOR POTENTIAL CONTAMINANT MIGRATION

(3)

TABLE 4-1. DATA SUMMARY FOR POTENTIAL CONTAMINATION SOURCES

Site name	Waste material/quantity	Period of use
Current Firefighting Training Area	JP-4 (currently 3000 gal/yr not consumed in fires), avgas, waste engine oil, transformer oil (2 drums), solvents, etc. (>100 drums)	1958 - Present
Former Firefighting Training Area	Avgas and waste engine oil, (assume 3000 gal/yr), solvents	1950(?) - 1958 1950(?) - 1958
Sanitary Landfill	General refuse, herbicides (8 drums or more), transformer oil (small amount), hydraulic fluid, batteries, formaldehyde (2-3 pallets), solvents, blank small arms ammunition, paints, DDT powder, hospital materials (8 truckloads), fuel tank sludges (assume >100 drums of misc. wastes)	1940 - Present
Avgas Fuel Test Dump Site	Avgas (assume 50,000 gal. or more)	1955 - 1970
Railyard Fuel Pumping Station	Avgas, JP-4 (assume 10,000 gal. or more)	1959 - 1965
Non-Destructive Test Lab	Solvents, penetrant, emulsifier, developer (assume 450 gal/yr)	1955 - 1970

Note: Landfilling of hazardous wastes ceased in 1980.

TABLE 4-2. SUMMARY OF HARM SCORES FOR POTENTIAL CONTAMINATION SOURCES

Rank	Site name	Receptor subscore	Waste characteristics subscore	Pathways subscore	Waste management factor	Overall total score
1	Current Firefighting Training Area	62	100	80	1	81
2	Former Firefighting Training Area	66	100	61	1	76
3	Sanitary Landfill	66	75	80	1	74
4	Avgas Fuel Test Dump Site	66	100	46	1	71
5	Railyard Fuel Pumping Station	64	100	46	1	70
6	Non Destructive Test Lab	66	60	61	1	62

CHAPTER 5

CONCLUSIONS

The purpose of the IRP Phase I study is to identify sites where the potential exists for environmental contamination resulting from past waste management practices and to assess the probability of contaminant migration from these sites. Our conclusions are based on the assessment of the information collected from field inspection, review of records and files, review of the environmental setting, and interviews with Base personnel, past employees and state and local government employees. Table 5-1 shows a list of the six sites at Otis ANG Base that were rated using the HARM model. These sites were chosen from the numerous sites shown in Figure 4-1 because they contain or contained hazardous wastes or materials and exhibit potential for migration of those wastes or materials.

1. The current firefighting training area has a high potential for migration of contaminants. Waste oils, fuels, and waste solvents and other possible hazardous wastes were burned at this area from 1958 to the present. The area was unlined until recently, and the permeable soils were not pre-saturated with water to limit infiltration of the flammable materials. The water table is about 50 feet below the site, and no impermeable materials probably occur between the surface

TABLE 5-1. PRIORITY RANKING OF POTENTIAL CONTAMINATION SOURCES

Rank	Site name	Date of operation or occurrence	Overall total score
1	Current Firefighting Training Area	1958-Present	81
2	Former Firefighting Training Area	1950(?)-1958	76
3	Sanitary Landfill	1940-Present	74
4	Avgas Fuel Test Dump Site	1955-1970	71
5	Railyard Fuel Pumping Station	1959-1965	70
6	Non Destructive Test Lab	1955-1970	62

Note: This ranking was performed according to the Hazardous Assessment Rating Methodology (HARM) described in Appendix B. Individual site rating forms are included in Appendix E.

and the groundwater system. A shallow well that was drilled several hundred feet downgradient of the area reportedly produced water with a hydrocarbon odor. Water quality data from the well are not available. The area is about 1,200 feet from the Base boundary. It is about 9,000 feet from the nearest large capacity water supply well (Base Well GW-G) and 9,500 feet from the nearest downgradient supply well (Ashumet Well-Falmouth). The current firefighting training area received a HARM score of 82.

2. The former firefighting training area also has a high potential for contaminant migration. Waste oils (largely heavy engine oils from the Constellations), fuels, and waste solvents and other possibly hazardous wastes were burned at the site from 1950(?) to 1958. The area was unlined and was located in a drainage channel. The water table is about 40 feet deep at the site. The area is about 2,000 feet from the Base boundary, and one mile from Base supply Well GW-J. The HARM score for this site is 76.

3. The Base landfill has a high potential for migration of contamination. It was used from about 1940 to the present and contains a variety of hazardous wastes. The landfill is covered with permeable materials that allow infiltration of precipitation which may contribute to the generation of leachate. No impermeable layers

are known to occur between the base of the landfill at elevation 110 feet above msl and the water table at elevation 60 feet above msl. The landfill is a possible source of the volatile organic chemicals in well GW-G, which is downgradient from the eastern edge of the landfill at a distance of 6,000 feet. The landfill is within the recharge area of well GW-G. It is adjacent to the Otis ANG Base boundary with Camp Edwards and is about 3,000 feet from the nearest privately-owned property. The HARM score for the landfill is 74.

4. The avgas fuel test dumping site was used from 1955 to 1970 and had a high potential for contaminant migration during that period. Most if not all of the fuel has probably moved through the unsaturated zone and migrated downgradient in the groundwater system. The fuel would remain on top of the groundwater. Small concentrations of some fuel components would dissolve in the underlying groundwater and move in that system. According to the existing water table map, the fuel would move south toward the Quashnet River. The area beneath which the plume would move is a sparsely populated portion of Mashpee. Mashpee has no municipal water system. The site is about 1,000 feet from the Base boundary and slightly more than one mile from Base supply Well GW-J. The HARM score for the dumping site is 71.

5. The rail yard fuel pumping station had a high potential for migration of contamination while it was in use. Since it has not been used for a number of years, most if not all of the fuel has probably moved through the unsaturated zone and migrated downgradient in the groundwater system. The fuel from the pumping station would probably move south then east toward Buzzards Bay, according to the existing water table map. The station is 500 feet from the Base boundary and slightly more than one mile from Base supply Well GW-G. The HARM score for the pumping station is 70.

6. The former non-destructive testing lab in Bldg. 3146 had an on-site disposal system that received small quantities of hazardous waste during its period of operation. The site has been abandoned for approximately 10 to 12 years, but probably had a high potential for contaminant migration during the period of use. Small quantities of waste would have been associated with this site, and it has a HARM score of 62.

CHAPTER 6

RECOMMENDATIONS

The sites that were rated at Otis ANG Base include three categories of activities. The first category, disposal sites which are believed to have received hazardous wastes, includes the Base landfill and the former non-destructive test lab. The second category, training or testing sites where hazardous materials were released to the environment, includes the current and former fire-fighting training areas and the avgas fuel test dumping site. The third category, sites associated with the storage and transportation of hazardous materials at which spills occurred, includes the rail yard fuel pumping station.

Disposal Sites

1. The Base landfill has a high potential for migration of contamination. An investigation should be conducted to determine if leachate from the landfill is contaminating the downgradient groundwater. Eight multilevel wells should be installed initially. One well should be upgradient, and four wells should be downgradient and close to the edge of the site, such as along Perkins Road. The other three wells should be further downgradient, with the locations dependent on water quality and water level data from the first five wells. Table 6-1 shows the recommended analytical parameters for the landfill investigation.

TABLE 6-1. RECOMMENDED ANALYTICAL PARAMETERS

Site(s)	Samples	Analytical Parameters
Current Firefighting Training Area and Former Firefighting/Non-destructive Test Lab Site	Groundwater from monitoring wells and Water extract of soil	PCB Lead Waterborne petroleum oils (ASTM D-3328-78) Purgeable organics (groundwater only)
Base Landfill	Groundwater from Well G	Priority pollutants (purgeables, base/neutrals, metals, pesticides, PCB, acid extractables)
	Groundwater from monitoring wells	Priority pollutants (purgeables, metals, pesticides, PCB) NOTE: Additional parameters should be considered based on results from Well G analyses.
Avgas Fuel Test Dump Site and Railyard Fuel Fuel Pumping Station	Groundwater from downgradient wells and Water extract of soil	Lead Waterborne petroleum oils (ASTM D-3328-78) Benzene, toluene (EPA Method 602)

It is recommended that one of the downgradient multilevel wells be placed close enough to Well GW-G to determine if landfill leachate (if any) is entering the well. The landfill is at the edge of the recharge area of Well GW-G, as it is delineated by the Cape Cod Planning and Economic Development Commission. Well recharge areas are difficult to delineate accurately without good water-level data, and the plume (if any) may or may not flow to the well. The former hospital area 2,000 feet north of the Well GW-G is a possible site for the multilevel well, but the final location should be selected after the early field data are available. The organic chemicals in Well GW-G may or may not originate in the landfill; the water quality data from the well, compiled in Appendix C, do not show evidence of significant leachate contamination.

2. The former non-destructive test lab on-site disposal system has a high potential for contaminant migration. The site is close to the former firefighting training area and the monitoring program for the two sites should be combined. First, the sites should be accurately located in the field. Exploration with a backhoe should be conducted to verify the site locations and to examine the upper soils. If contamination is detected, either from odor or by visual examination, then extractions should be tested to determine the constituents. One upgradient

and three downgradient multilevel wells should be installed and tested for the parameters shown in Table 6-1.

Training or Testing Sites

1. The current and former firefighting training areas have a high potential for contaminant migration. The former firefighting training area has been combined with the non-destructive test lab site because they are adjacent. The current firefighting training site should be investigated in a similar fashion. Test pits should first be dug to assess upper soil contamination. Multilevel monitoring wells should be installed, one upgradient and three downgradient from the site. The recommended analytical program is shown in Table 6-1.
2. The avgas fuel test dumping training area has been inactive for many years, but had a high potential for contaminant migration during its period of use. Test pits should be dug at the site. A visual inspection should reveal if any residuals are in the soil. Water extractions from the soil samples should be tested if residual contamination is apparent. Wells in the projected plume path should be sampled. The Quashnet River, which is the nearest downgradient candidate groundwater discharge point, is about 10,000 feet from the site. Dissolved non-reactive constituents would move that distance in about 14 to 28 years, assuming a groundwater flow velocity of one to two feet per day.

The movement of fuels on top of the water table is more difficult to predict. For this reason, it is recommended that existing wells in the projected plume path be tested for the parameters shown in Table 6-1. Only a few wells are located between the site and the Quashnet River.

Hazardous Materials Storage and Transportation Sites

The rail yard fuel pumping station had a high potential for contaminant migration during its period of use. Most of the fuel that was spilled has probably migrated away, creating a situation similar to the avgas fuel test dumping area. A program like that recommended for the avgas fuel test dumping site should be conducted for this site also.

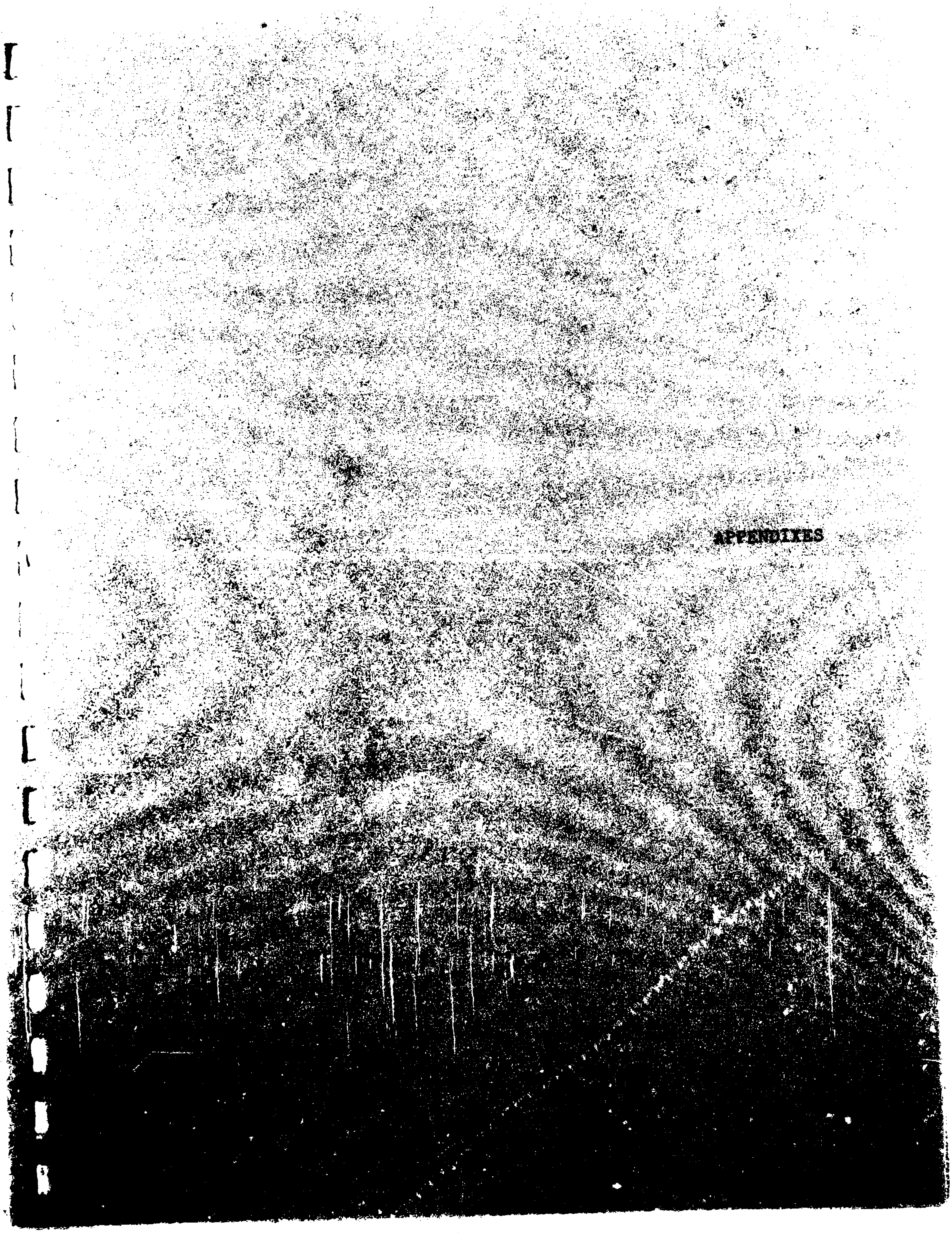
Respectfully submitted,

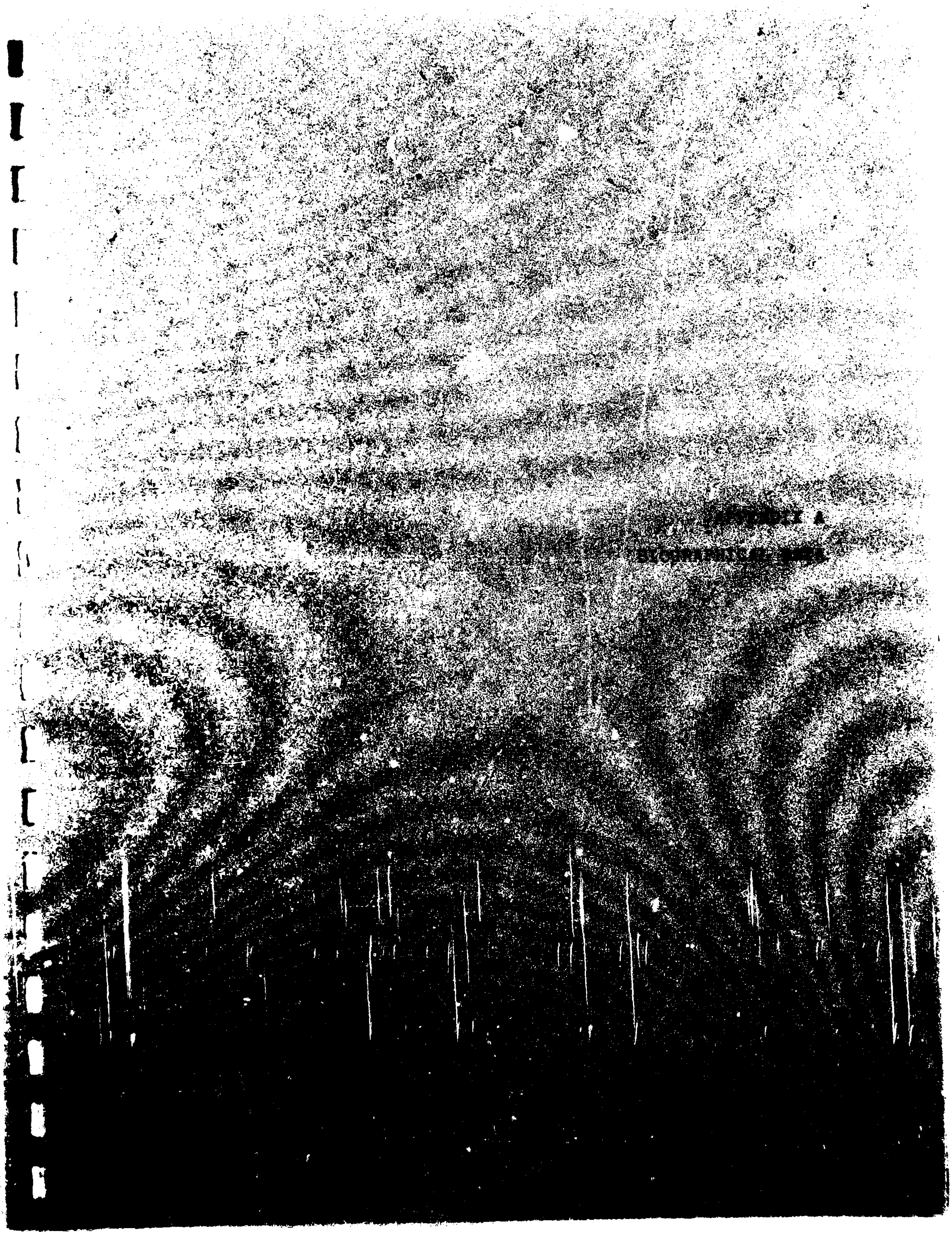
METCALF & EDDY, INC.

Richard L. Ball

Richard L. Ball, Jr.
Vice President

APPENDIXES




APPENDIX A
BIOGRAPHICAL

RICHARD L. BALL, JR.

BS, Physics, Loyola College, 1958
BES, Civil Engineering, Johns Hopkins University, 1962
MSE, Water Resources Engineering, Johns Hopkins University, 1962

Member:
American Planning Association
American Institute of Certified Planners
National Recreation and Parks Association
Urban Land Institute

Associated with Metcalf & Eddy since 1963, Mr. Ball is Vice President and Director of the firm's Environmental Planning Division. In this position he holds overall responsibility for the firm's professional services in municipal and community planning, regional planning, environmental impact analyses, conservation and recreation planning and facility design, transportation engineering, community development, and land/site planning.

Mr. Ball's technical background is in comprehensive planning; socio-economic and fiscal studies; areawide water, sewer, wastewater and solid waste system planning; and water resources planning. He had prime responsibility for the preparation of comprehenisve plans in 30 municipalities in Connecticut, Massachusetts, New Jersey and New Hampshire.

Major regional studies he recently directed include the Edwards Aquifer Protection Plan in San Antonio, Texas. The study involved projection of growth policies, determination of water quality, fiscal and institutional impacts, and the development of legal controls to protect this sole source of water supply. For the Association of Central Oklahoma Governments, Mr. Ball directed the environmental assessment phase of the 208 Areawide Waste Treatment Management Plan, which examined regional land use and involved forecasting future population and employment growth and patterns.

Mr. Ball is the author of a paper entitled "Land Use Planning as a Tool for Controlling Water Demands in a Distribution System" presented at a conference of the American Water Works Association and published in Water and Sewerage Magazine. In addition, he recently participated in a symposium sponsored by the City of Austin, Texas Department of Environmental Resource Management at which he spoke on the possible regulatory and policy schemes for controlling development and protecting the contributing and recharge zones of the Edwards Aquifer.

Mr. Ball also directs the U.S. Environmental Protection Agency, Region I mission contract. The comprehensive program is assessing the impacts of disinfection on cold water fisheries, developing a data management and quality evaluation procedure for PCB's in the Acushnet River Estuary, and is completing a use attainability analysis of the Pawtuxet River, Rhode Island watershed.

WARREN F. DIESL

BS, Geology, St. Lawrence University, 1972
MS, Geology, University of Rhode Island, 1976

Certified Professional Geologist

Member:

National Water Well Association

Mr. Diesl is a hydrogeologist assigned to Metcalf & Eddy's Geotechnical Department. His duties include groundwater exploration, groundwater contamination studies, and aquifer analysis.

Mr. Diesl conducted a hydrogeologic investigation for a leachate control study for the town of Danvers, Massachusetts, sanitary landfill. The study involved a determination of the primary cause of leachate production and recommendation of a means of leachate control. Mr. Diesl's responsibilities included water budget analysis, observation well installation, determination of groundwater flow patterns, and field water quality analyses.

He also conducted a hydrogeologic investigation for an effluent plume study for the Town of Chatham, Massachusetts water pollution control plant. Mr. Diesl's responsibilities included water budget analysis, observation well installation, determination of groundwater flow patterns, and field water quality analyses.

Mr. Diesl has conducted several investigations for land application projects. At Darlington, South Carolina, he planned and conducted a hydrogeologic/soils investigation for the design of a 1-6 mgd rapid infiltration system. The study included borings, infiltration testing, well installation, mounding analysis, and underdrain spacing calculations. In Maryland, Mr. Diesl conducted a hydrogeological/soils study for a smaller rapid infiltration system that included soil mapping, borings, well installation, mounding and underdrain analyses, and groundwater flow determination.

Mr. Diesl performed an analysis of groundwater conditions relating to the advisability of rehabilitating or replacing an old tubular wellfield in the town of Burlington, Massachusetts. The hydrogeologic aspects of the study included formulation of a groundwater and surface water sampling program, analysis of water quality data showing contamination by organic and inorganic constituents, and analysis of aquifer yield.

MICHAEL J. MEAGHER

BS, Civil Engineering, Norwich University, 1965

Member:
American Society of Civil Engineers
Amercian Society of Mechanical Engineers,
Solid Waste Processing Division

Mr. Meagher is a Project Manager in the Solid Waste Division. He joined the firm in 1974 with seven years of prior experience in solid waste management. His background includes designs and studies on resource recovery facilities. Following are examples of his projects:

- Feasibility study, RFP preparation, evaluation and negotiations for the 240-tpd refuse-to-steam plant in Pittsfield, Massachusetts.
- Regional Springfield, Massachusetts Monsanto feasibility study, a 760-tpd refuse-to-steam facility which will supply steam to Monsanto Company.
- Project Manager for a report and design of a landfill for Amherst, Massachusetts. The project involved site identification, obtaining approvals, design of a liner and leachate disposal system and development of an operating plan.
- Project Manager for a report to recommend methods to correct leachate problems at a landfill site for Danvers, Massachusetts. Also included was development of capital and annual operating cost estimates
- Project Manager for a solid waste management plan for Hudson, New Hampshire.
- Project Manager for 600-tpd solid waste disposal alternative study and feasibility study for refuse-to-energy plant outside the city of Worcester.
- Charlottsville, Virginia feasibility study for a 250 to 450-tpd refuse-to-steam plant which examined energy recovery systems.

DR. EDWARD J. CICHON

BS, Chemistry, Tufts University, 1976
PhD, Chemistry, Brown University, 1980

Member:
American Water Works Association
American Chemical Society

Dr. Cichon serves as a Technical Specialist in the areas of Chemical Process, Hazardous Waste and Chemistry, incorporating his extensive experience in analytical, organic and inorganic chemistry. In addition, he is responsible for the coordination, supervision and data evaluation of pilot plant and bench-scale studies. He has worked with state-of-the-art analytical techniques for both process control and evaluation.

Dr. Cichon has been and is presently engaged in projects involving water, wastewater, and hazardous waste treatment. These projects include state-of-the-art pilot studies for removing volatile organics from drinking water by the use of air-stripping and activated carbon. In the area of wastewater he has been involved with projects that have focused on such issues as the removal of heavy metals from iron and steel mill wastes, and the chemistry of various inorganic and organic pollutants in industrial wastewaters.

Recent pilot plant experience includes:

Connecticut Water Company. Water Treatment for Potable Use - Responsible for the development, operation and data interpretation of an ozone - P.E. pilot filtration plant. Of major concern was the reduction in the trihalomethane formation potential by ozone. Over 100 THMFP tests were conducted over a 6-week period to assess the reduction of this parameter through the treatment train.

Suffolk County Water Authority. Water Treatment for Potable Use - Responsible for developing and implementing a three-stage field pilot program to develop design criteria for the removal of organic chemicals from well water by packed tower aeration. Besides being responsible for pilot plant design and data evaluation, Dr. Cichon provided seminars to the Water Authority personnel for the purpose of explaining the theory and operation of this treatment technology.

Metropolitan District Commission, Boston. Water Treatment for Potable Use - Responsible for the operation of a 250 gpm pilot plant for evaluating the effectiveness of pulsator clarification, plate settling, and direct filtration to treat water from the Sudbury reservoir. Included in the testing program was an evaluation of the unit process to reduce the trihalomethane formation potential (THMFP) in the raw water. THMFP tests were designed to simulate the complex downstream chlorination practices and reservoir detention periods.

ARTHUR MICHELINI, JR.

BS, Bacteriology, Ohio State University, 1958

Mr. Michelini is in direct charge of the analytical and research work performed by Metcalf & Eddy's water and wastes laboratories. He supervises the laboratory technicians and is responsible for implementation of analytical studies. With the firm since 1967, Mr. Michelini has nearly 20 years of laboratory experience.

Under Mr. Michelini's direction, the Metcalf & Eddy laboratory performs a full range of chemical, physical and biological water quality analyses. Laboratory equipment includes an atomic absorption spectrophotometer, an organic carbon analyzer, pH instruments, a turbidimeter, a conductivity meter, and a complement of field sampling and analysis equipment.

Mr. Michelini directed preliminary studies for a confidential investigation of the performance of five different granular activated carbons. He conducted the isotherms and held overall responsibility for the field pilot studies.

Mr. Michelini is experienced in the techniques and programs involved in water quality analyses. He has directed numerous studies in this area, including analyses of the Town of Plymouth, Massachusetts' surface water bodies. In addition, he is participating in a continuous program of ground and surface water evaluation for Chatham, Massachusetts.

RICHARD G. SHERMAN

University of Colorado, BS, Geology, 1953

Member:
Boston Society of Civil Engineers
Association of Engineering Geologists
Society of American Military Engineers
American Institute of Professional Geologists

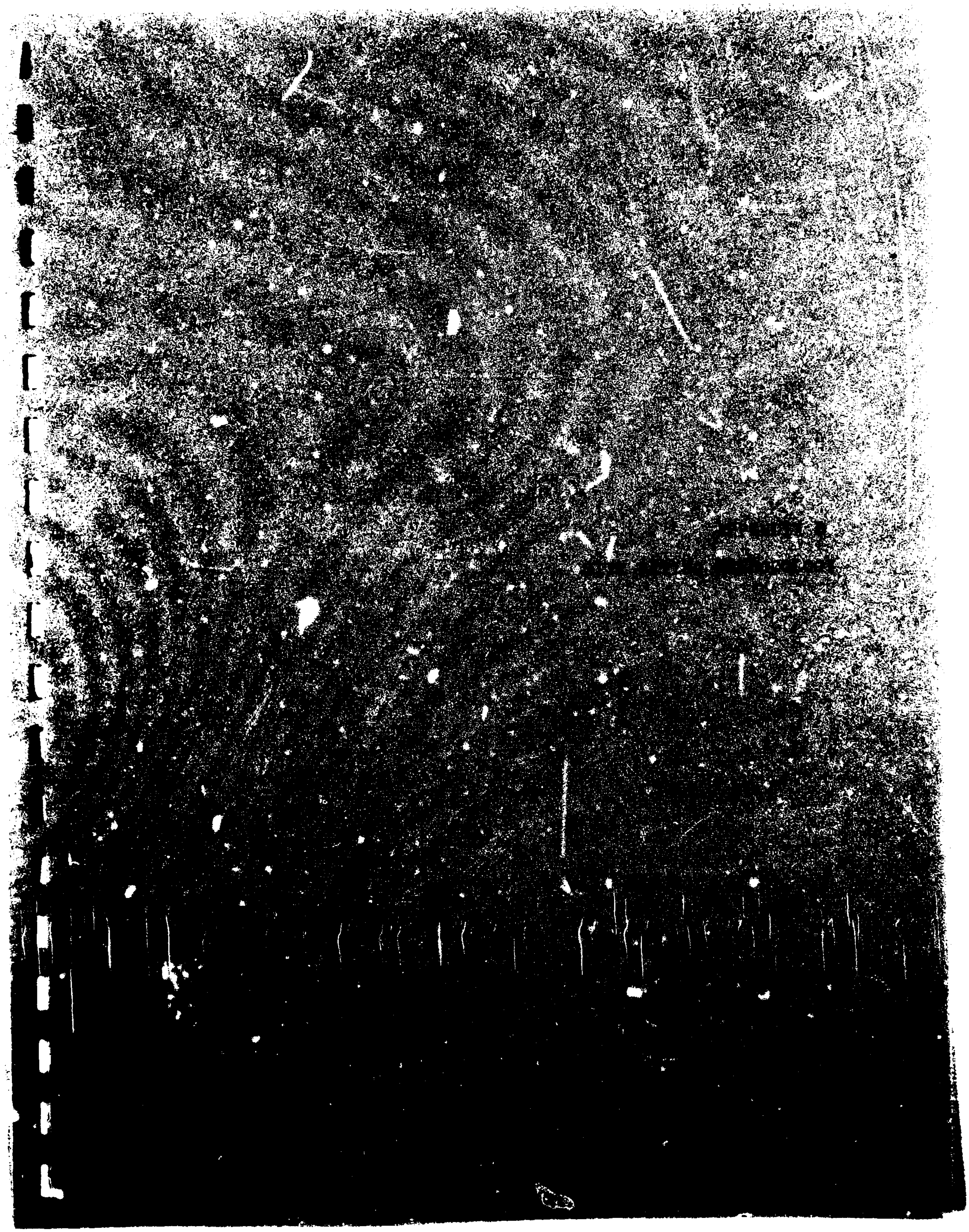
Registered Geologist, California, Idaho and Delaware
Certified Geologist, Maine

Mr. Sherman is Chief, Geotechnical Department with responsibility for administrative and technical supervision covering disciplines of soil and materials engineering, hydrogeology, geology, and oceanography.

He has been responsible for interpreting subsurface data for engineering application and design recommendations on bridges, dams, tunnels and building foundations; terrain analyses for selection of water intake, sewer outfall, water and sewage treatment plant sites; and terrain studies for site feasibility of military and industrial facilities. His assignments have included projects in Arctic North America, Continental United States, South and Central America, Europe and the Caribbean.

Mr. Sherman's project experience includes: design, pile load tests and construction of new dock for Port of Seward Alaska damaged in 1964 earthquake; repair of foundations at Whittier, Alaska; Port Anchorage, Alaska dock facilities and Government dock; and design review of temporary tanker off loading dock at Anchorage. More recently he has been involved in design and construction services in connection with foundations for the New England Aquarium, Boston and a town dock in Manchester, Massachusetts. Previous assignments include the feasibility study of filling Bird Island Flats for Massport, design and construction of the concrete apron for Eastern Airlines and facilities at TWA, all at Logan Airport in Boston.

He prepared geologic and foundation studies of Deer Island drumlin, Nut Island and various other sites around Boston Harbor. The work required feasibility studies for cross-harbor pipelines and tunnels. He has worked on over 20 shorefront projects and over 60 highway projects, including back-slope dranage, underdrainage and cut-slope stabilization.



APPENDIX B

SITE RATING METHODOLOGY
FOR
PHASE I INSTALLATION RESTORATION PROGRAM

Background

The Department of Defense (DOD) has established a comprehensive program to identify, evaluate, and control problems associated with the past disposal practices at DOD facilities. One of the actions required under this program is to:

> "develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts." (Reference: Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5,11 December 1981).

The site rating methodology for Phase I of the Installation Restoration Program (IRP) was jointly developed by CH2M/Hill and Engineering - Science based on experience in performing Record Searches at several Air Force Installations. The basis for the rating system is a document developed by JRB Associates, Inc. for the EPA Hazardous Waste Enforcement office. The JRB system was modified to accurately address specific Air Force installation conditions and to provide meaningful comparison of landfills and contaminated areas other than landfills.

After use of this first model for a period of time at several Air Force installations, certain inadequacies became apparent. In January 1982 USAF representatives, Engineering-Science, and CH2M/Hill developed a new site rating model to present a better picture of the hazards posed by sites at Air Force Installations. The new rating model described in this presentation is referred to as the Hazardous Assessment Rating Methodology (Table 1).

Purpose

The purpose of the site rating model is to provide a relative ranking of sites of suspected contamination from hazardous substances. This model will assist the Air National Guard Bureau in setting priorities for follow-on site investigations and confirmation work under Phase II of the IRP.

This rating system is used only after it has been determined that (1) potential for contamination exists (hazardous wastes present in sufficient quantity), and (2) potential for migration exists. A site can be deleted from consideration for rating on either basis. Figure 1-1 shows the decision tree that is used to determine whether or not to rate a site with the HARM system.

Description of Model

This site rating model uses a scoring system to rank sites for priority attention. However, in developing this model, the designers incorporated some special features to meet specific DOD program needs.

The model uses data readily obtained during the Record Search portion (Phase I) of the IRP. Scoring judgments and computations are readily made. In assessing the hazards at a given site, the model develops a score based on the most likely routes of contamination and the worst hazards at the site. Sites are given low scores only if there are clearly no hazards at the site.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: the possible receptors of the contamination, the waste and its characteristics, potential pathways for waste contaminant migration, and any efforts to contain the contaminants. Each of these categories contains a number of rating factors that are used in the overall hazard rating.

The receptors category rating is calculated by scoring each factor, multiplyirr by a factor weighting constant and adding the weighed scores to obtain a total category score.

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factor, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score, while scores for sludges and solids are reduced.

The pathways category rating is based on evidence of contaminant migration or an evaluation of the highest potential (worst case) for contaminant migration along one of three pathways. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence, 80 points are assigned, and for direct evidence 100 points are assigned. If no evidence is found, the highest score among three possible routes is used. These routes are surface water migration, flooding, and ground-water migration. Evaluation of each route involves factors associated with the particular migration route. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The scores for each of the three categories are then added together and averaged to a maximum possible score of 100. Then the waste management practice category is scored. Sites at which there is no containment are not reduced in score. Scores for sites with limited containment can be reduced by 5 percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste management practices category factor to the sum of the scores for the other three categories.

AD-A136 931 INSTALLATION RESTORATION PROGRAM PHASE I RECORDS SEARCH OTIS AIR NATIONAL GUARD BASE MASSACHUSETTS(U) METCALF AND EDDY INC BOSTON MA JAN 83 DAHA19-82-C-0015 2/2

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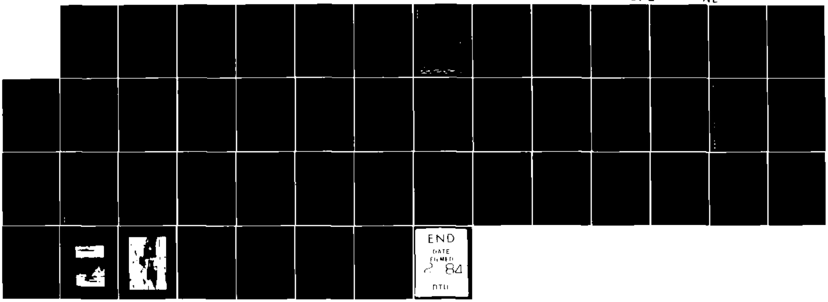
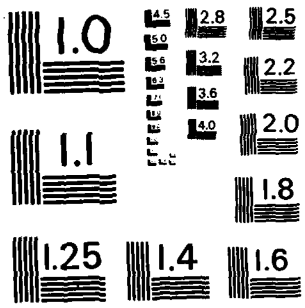




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

TABLE 1

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
A. Population within 1,000 feet (includes on-base facilities)	0	1 - 25	26 - 100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Land Use/Zoning (within 1 mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or industrial	Residential	3
D. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	6
E. Critical environments (within 1 mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wetlands; preserved areas; presence of economically important natural resources susceptible to contamination.	Major habitat of an endangered or threatened species; presence of recharge area; major wetlands.	10
F. Water quality/use designation of nearest surface water body	Agricultural or industrial use.	Recreation, propagation and management of fish and wildlife.	Shellfish propagation and harvesting.	Potable water supplies	6
G. Ground-Water use of uppermost aquifer	Not used, other sources readily available.	Commercial, industrial, or irrigation, very limited other water sources.	Drinking water, municipal water available.	Drinking water, no municipal water available; commercial, industrial, or irrigation, no other water source available.	9
H. Population served by surface water supplies within 3 miles downstream of site	0	1 - 50	51 - 1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1 - 50	51 - 1,000	Greater than 1, 000	6

TABLE 1 (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

S = Small quantity (<5 tons or 20 drums of liquid)
M = Moderate quantity (5 to 20 tons or 21 to 85 drums of liquid)
L = Large quantity (>20 tons or 85 drums of liquid)

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

- o Verbal reports from interviewer (at least 2) or written information from the records.
- o Knowledge of types and quantities of wastes generated by shops and other areas on base.
- o Based on the above, a determination of the types and quantities of waste disposed of at the site.

S = Suspected confidence level

- o No verbal reports or conflicting verbal reports and no written information from the records.
- o Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at a site.

A-3 Hazard Rating

Hazard Category	Rating Scale Levels 0	1	2	3
Toxicity	Sax's Level 0	Sax's Level 1	Sax's Level 2	Sax's Level 3
Ignitability	Flash point greater than 200°F	Flash point at 140°F to 200°F	Flash point at 80°F to 140°F	Flash point less than 80°F
Radioactivity	At or below background levels	1 to 3 times background levels	3 to 5 times background levels	Over 5 times background levels

Use the highest individual rating based on toxicity, ignitability and radioactivity and determine the hazard rating.

Hazard Rating	Points
High (H)	3
Medium (M)	2
Low (L)	1

TABLE 1 (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

II. WASTE CHARACTERISTICS (Continued)

Waste Characteristics Matrix

Point Rating	Hazardous Waste Quantity	Confidence Level of Information	Hazard Rating
100	L	C	H
80	L	C	H
	M	C	H
70	L	S	H
60	S	C	H
	M	C	M
50	L	S	M
	L	C	L
	M	S	H
	S	C	M
40	S	S	H
	M	S	M
	M	C	L
	L	S	L
30	S	C	L
	M	S	L
	S	S	M
20	S	S	L

Notes:
For a site with more than one hazardous waste, the waste quantities may be added using the following rules:
Confidence Level
o Confirmed confidence levels (C) can be added
o Suspected confidence levels (S) can be added
o Confirmed confidence levels cannot be added with suspected confidence levels
Waste Hazard Rating
o Wastes with the same hazard rating can be added
o Wastes with different hazard ratings can only be added in a downgrade mode, e.g., MCM + SCH = LCM if the total quantity is greater than 20 tons.
Example: Several wastes may be present at a site, each having an MCM designation (60 points). By adding the quantities of each waste, the designation may change to LCM (80 points). In this case, the correct point rating for the waste is 80.

B. Persistence Multiplier for Point Rating

Persistence Criteria	Multiply Point Rating From Part A by the Following
Metals, polycyclic compounds, and halogenated hydrocarbons	1.0
Substituted and other ring compounds	0.9
Straight chain hydrocarbons	0.8
Easily biodegradable compounds	0.4

C. Physical State Multiplier

Physical State	Multiply Point Total From Parts A and B by the Following
Liquid	1.0
Sludge	0.75
Solid	0.50

TABLE 1 (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

III. PATHWAYS CATEGORY

A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, ground water, or air. Evidence should confirm that the source of contamination is the site being evaluated.

Indirect evidence might be from visual observation (i.e., leachate), vegetation stress, sludge deposits, presence of taste and odors in drinking water, or reported discharges that cannot be directly confirmed as resulting from the site, but the site is greatly suspected of being a source of contamination.

B-1 POTENTIAL FOR SURFACE WATER CONTAMINATION

Rating Factor	Rating Scale Levels 0	1	2	3	Multiplier
Distance to nearest surface water (includes drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 in.	-10 to + 5 in.	+5 to +20 in.	Greater than +20 in.	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($<10^{-6}$ cm/sec)	6
Rainfall intensity based on 1 year 24-hr rainfall	<1.0 inch	1.0-2.0 inches	2.1-3.0 inches	>3.0 inches	8

B-2 POTENTIAL FOR FLOODING

Rating Factor	0	1	2	3	Multiplier
Floodplain	Beyond 100-year floodplain	In 25-year floodplain	In 10-year floodplain	Floods annually	1

B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION

Rating Factor	0	1	2	3	Multiplier
Depth to ground water	Greater than 500 ft	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 in.	-10 to +5 in.	+5 to +20 in.	Greater than +20 in.	6
Soil permeability	Greater than 50% clay ($>10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay ($<10^{-2}$ cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high ground-water level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean ground-water level	8
Direct access to ground water (through faults, fractures, faulty well casings, subsidence fissures, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

TABLE 1 (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

IV. WASTE MANAGEMENT PRACTICES CATEGORY

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and engineering controls designed to reduce this risk. The total risk is determined by first averaging the receptors, pathways, and waste characteristics subscores.

B. WASTE MANAGEMENT PRACTICES FACTOR

The following multipliers are then applied to the total risk points (from A):

Waste Management Practice	Multiplier
No containment	1.0
Limited containment	0.95
Fully contained and in full compliance	0.10

Guidelines for fully contained:

Landfills:

- o Clay cap or other impermeable cover
- o Leachate collection system
- o Liners in good condition
- o Adequate monitoring wells

Surface Impoundments:

- o Liners in good condition
- o Sound dikes and adequate freeboard
- o Adequate monitoring wells

Spills:

- o Quick spill cleanup action taken
- o Contaminated soil removed
- o Soil and/or water samples confirm total cleanup of the spill

Fire Proection Training Areas:

- o Concrete surface and berms
- o Oil/water separator for pretreatment of runoff
- o Effluent from oil/water separator to treatment plant

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1 or III-B-3, then leave blank for calculation of factor score and maximum possible score.

WATER QUALITY DATA - WELL G 5/48 - 11/60

Sample Date	5/48	6/51	3/53	9/53	3/54	5/55	4/56	11/56	8/59	11/60
Laboratory*	3	3	3	3	3	3	3	3	3	3
PHYSICAL EXAMINATION										
Color, PCU	2	1	0	3	7	4	2	3	7	3
Odor, TON										
Sediment, ml										
Solids, Residue at 180 deg C, dis., mg/l	39	42	75	52	39	60	48		44	57
Solids, sum of, dis., mg/l	39	42	75	52	39	60	48		44	57
Specific Conductance umhos/cm.	59	57	138	73	57	86	73	79	76	88
Temp., deg. C	9.4	10.0		13.3	10.5	10.0	[illegible].9	12.2	15.5	12.2
Turbidity, NTU										
METAL ANALYSIS										
Arsenic as As, mg/l										
Barium as Ba, mg/l										
Cadmium as Cd, mg/l										
Calcium as Ca, mg/l										
Calcium, dis., as Ca, mg/l	1.9	2.2	6.3	4.1	2.5	3.1	4.6	4.4	3.2	4.2
Chromium as Cr, mg/l										
Copper as Cu, mg/l										
Iron as Fe, mg/l	0.31	0.24	0.06	0.04	0.10	0.07	0.29	-	0.02	0.09
Lead as Pb, mg/l										
Magnesium as Mg, mg/l										
Magnesium, dis., as Mg, mg/l	1.7	1.2	3.5	3.3	1.0	1.8	1.8	2.3	1.8	2.6
Manganese as Mn, mg/l							0.08		0.03	0.20
Mercury as Hg, mg/l										
Potassium as K, mg/l										
Potassium, dis., as K, mg/l										
Selenium as Se, mg/l										
Silver as Ag, mg/l										
Sodium as Na, mg/l										
Sodium, dis., as Na, mg/l										
INORGANIC ANALYSIS										
Alkalinity, Total, as CaCO3, mg/l	7	7	8	19	8	22	15	16	10	10
Bicarbonates as HCO3, mg/l	9	9	10	23	10	27	18	19	12	12
Boron as B, mg/l										
Carbonates as CO3, mg/l	0	0	0	0	0	0	0	0	0	0
Carbon Dioxide as CO2, mg/l	3.6	2.9	13	5.8	6.4	5.4	18	19	-	3.0
Chloride as Cl, mg/l										
Chloride, dis., as Cl, mg/l	9.9	9.5	20	8.7	9.0	10	9.5	9.5	12	3.3
Fluoride as F, mg/l										
Fluoride, dis., as F, mg/l	.0	0.1	.0	.0	.0	0.1	.0	.0	.0	.0
Hardness, Total, as CaCO3, mg/l	12	10	30	24	10	15	19	21	16	21
Hardness, Non-carbonate, as CaCO3, mg/l	5	3	22	5	2	0	4	5	6	11

*1. Mass. DEQE
2. Brooks AFB
3. USGS
4. Unknown

WATER QUALITY DATA - WELL G 5/48 - 11/60

Sample Date	5/48	6/51	3/53	9/53	3/54	5/55	4/56	11/56	8/59	11/60
Laboratory	3	3	3	3	3	3	3	3	3	3
Nitrogen, Ammonia, as N, mg/l										
Nitrogen, Ammonia, dis., as N, mg/l										
Nitrogen, Ammon. + Org., as N, mg/l										
Nitrogen, Nitrate, as N, mg/l	0.07	0.16	2.9	0.14	0.14	0.45	0.02	0.59	0.02	0.52
Nitrogen, Nitrate, dis , as N, mg/l										
Nitrogen, Nitrite, as N, mg/l										
Nitrogen, Nitrite, dis., as N, mg/l										
Nitrogen, Organic, dis., as N, mg/l										
Oxygen, dissolved, mg/l										
pH units	6.6	6.7	6.1	6.8	6.4	6.9	6.2	6.2	5.5	6.8
Phosphate, Ortho, dis., as P, mg/l										
Phosphate, Total, dis., as P, mg/l										
Silica, as SiO2, mg/l										
Silica, as SiO2, dis., mg/l	9.9	9.7	9.4	11	41	11	10	10	9.0	10
Sulfate as SO4, mg/l										
Sulfate, dis., as SO4, mg/l	4.4	5.8	6.6	6.2	4.6	5.6	5.8	6.0	4.7	15
Surfactants, (MBAS), mg/l										
ORGANIC ANALYSIS										
Methylene Chloride, ug/l										
1,1-dichloroethylene, ug/l										
1,1-dichloroethane, ug/l										
1,2-trans-dichloroethylene, ug/l										
Chlorofrom, ug/l										
1,2-dichloroethane, ug/l										
1,1,1-trichloroethane, ug/l										
Carbon tetrachloride, ug/l										
Dichlorobromomethane, ug/l										
Trichloroethylene, ug/l										
Dibromochloromethane, ug/l										
Bromoform, ug/l										
Tetrachloroethylene, ug/l										
1,2-dichloroethylene, ug/l										
1,1,2,2-tetrachloreothylene, ug/l										
Toluene, ug/l										
Phenol, ug/l										
Total Trihalomethanes, ug/l										
Pesticides, ug/l										
Herbicides, ug/l										
Oil, mg/l										
BACTERIOLOGICAL ANALYSIS										
Coliforms, Total, per 100 ml.										
RADIOLOGICAL ANALYSIS										
Gross Alpha Count, P ci/l										
Gross Beta Count. P ci/l										
MISC. ANALYSIS										
Sodium Adsorption Ratio										

WATER QUALITY DATA - WELL G 10/61 - 10/71

Sample Date	10/61	6/25/62	2/14/63	1/64	2/15/65	1/12/66	12/66	5/8/67	11/69	10/26/71
Laboratory*	3	1	1	3	4	4	3	4	3	4
PHYSICAL EXAMINATION										
Color, PCU	3	10	5	1	5	7	2	0	6	5
Odor, TON		0	0		0	0		0		0
Sediment, ml		0	0		0	0		0		0
Solids, Residue at 180 deg C, dis., mg/l	59			61			60		49	
Solids, sum of, dis., mg/l	56			59			59		52	
Specific Conductance umhos/cm.	95			94			90		80	
Temp., deg. C	12.2			10.0			10.0		11.0	
Turbidity, NTU		0	0		0	0		0		0
METAL ANALYSIS										
Arsenic as As, mg/l										
Barium as Ba, mg/l										
Cadmium as Cd, mg/l										
Calcium as Ca, mg/l										
Calcium, dis., as Ca, mg/l	4.4			4.8			4.1		4.0	
Chromium as Cr, mg/l										
Copper as Cu, mg/l										
Iron as Fe, mg/l	0.11	0.08	0.05	0.11	0.07	0.15	0.07	0.01	0.01	0.05
Lead as Pb, mg/l										
Magnesium as Mg, mg/l										
Magnesium, dis., as Mg, mg/l	2.6			2.0			2.5		1.9	
Manganese as Mn, mg/l	0	0.06	0.10	0.10	0.04	0.04	0.09	0.04	0.01	0.00
Mercury as Hg, mg/l										
Potassium as K, mg/l										
Potassium, dis., as K, mg/l									0.6	
Selenium as Se, mg/l										
Silver as Ag, µg/l										
Sodium as Na, mg/l										13
Sodium, dis., as Na, mg/l									6.8	
INORGANIC ANALYSIS										
Alkalinity, Total, as CaCO3, mg/l	10	7	7	10	4	10	10	9	10	23
Bicarbonates as HCO3, mg/l	12			12			12		12	
Boron as B, mg/l										
Carbonates as CO3, mg/l	0			0			0		0	
Carbon Dioxide as CO2, mg/l				15			19		9.6	
Chloride as Cl, mg/l		9.5	11		10	10		3.0		11
Chloride, dis., as Cl, mg/l	8.3			9.1			9.8		11	
Fluoride as F, mg/l	.0			0.1			0.1		0.1	
Fluoride, dis., as F, mg/l										
Hardness, Total, as CaCO3, mg/l	22	20	24	20	32	28	20	23	18	28
Hardness, Non-carbonate, as CaCO3, mg/l	12			10			10		8	

*1. Mass. DEQE
2. Brooks AFB
3. USGS
4. Unknown

WATER QUALITY DATA - WELL G 10/61 - 10/71

Sample Date	10/61	6/25/62	2/14/63	1/64	2/16/65	1/12/66	12/66	5/8/67	11/69	10/26/71
Laboratory	3	1	1	3	4	4	3	4	3	4
Nitrogen, Ammonia, as N, mg/l										0.00
Nitrogen, Ammonia, dis., as N, mg/l										
Nitrogen, Ammon. + Org., as N, mg/l										
Nitrogen, Nitrate, as N, mg/l	0.47	0.30	0.30	C.56	1.8	0.5	0.18	0.6	0.66	0.5
Nitrogen, Nitrate, dis., as N, mg/l										
Nitrogen, Nitrite, as N, mg/l		.00	.00		0.000	0.000		0.001		0.000
Nitrogen, Nitrite, dis., as N, mg/l										
Nitrogen, Organic, dis., as N, mg/l										
Oxygen, dissolved, mg/l										
pH units	5.8	5.9	5.9	6.1	5.9	6.1	6.0	6.2	6.3	6.6
Phosphate, Ortho, dis., as P, mg/l										
Phosphate, Total, dis., as P, mg/l										
Silica, as SiO2, mg/l										
Silica, as SiO2, dis., mg/l	10			10			10		10	
Sulfate as SO4, mg/l										
Sulfate, dis., as SO4, mg/l	15			15			16		8.6	
Surfactants, (MBAS), mg/l										
ORGANIC ANALYSIS										
Methylene Chloride, ug/l										
1,1-dichloroethylene, ug/l										
1,1-dichloroethane, ug/l										
1,2-trans-dichloroethylene, ug/l										
Chloroform, ug/l										
1,2-dichloroethane, ug/l										
1,1,1-trichloroethane, ug/l										
Carbon tetrachloride, ug/l										
Dichlorobromomethane, ug/l										
Trichloroethylene, ug/l										
Dibromochloromethane, ug/l										
Bromoform, ug/l										
Tetrachloroethylene, ug/l										
1,2-dichloroethylene, ug/l										
1,1,2,2-tetrachloroethylene, ug/l										
Toluene, ug/l										
Phenol, ug/l										
Total Trihalomethanes, ug/l										
Pesticides, ug/l										
Herbicides, ug/l										
Oil, mg/l										
BACTERIOLOGICAL ANALYSIS										
Coliforms, Total, per 100 ml.										
RADIOLOGICAL ANALYSIS										
Gross Alpha Count, P ci/l										
Gross Beta Count. P ci/l										
MISC. ANALYSIS										
Sodium Adsorption Ratio									0.7	

WATER QUALITY DATA - WELL G 12/71 - 1/79

Sample Date	12/71	4/2/74	1/28/75	5/12/75	12/1/75	3/2/76	4/76	8/30/76	3/20/78	1/21/79
Laboratory*	3	4	4	4	4	4	3	4	4	1
PHYSICAL EXAMINATION										
Color, PCU		5	3	0	0	0		3	0	
Odor, TON		0	0	0	0	2		2	2	
Sediment, ml		0	0	0	0	0		0	0	
Solids, Residue at 180 deg C, dis., mg/l	65						-			
Solids, sum of, dis., mg/l	-						66			
Specific Conductance umhos/cm.	97	84	74	88	120	128	97	135	[illegible]	
Temp., deg. C	11.0						10.0			
Turbidity, NTU		0	0	0	0	0		0	.2	
METAL ANALYSIS										
Arsenic as As, mg/l										0.0005
Barium as Ba, mg/l										0.000
Cadmium as Cd, mg/l										0.000
Calcium as Ca, mg/l		3.2	3.6	4.0	6.3	4.0		3.2	4.4	
Calcium, dis., as Ca, mg/l	5.0						4.5			
Chromium as Cr, mg/l										0.00
Copper as Cu, mg/l		0.00	0.02	0.00	0.02	0.00		0.00	0.03	
Iron as Fe, mg/l	0.02	0.03	0.04	0.03	0.20	0.03	0.10	0.03	0.03	
Lead as Pb, mg/l										0.00
Magnesium as Mg, mg/l		2.1	2.0	1.9	4.5	2.6		2.0	3.1	
Magnesium, dis., as Mg, mg/l	2.9						2.3			
Manganese as Mn, mg/l	0.03	0.01	0.00	0.00	0.00	0.00	0	0.00	0.00	
Mercury as Hg, mg/l										0.0001
Potassium as K, mg/l		0.8	0.8	0.8	1.2	1.0		1.2	1.0	
Potassium, dis., as K, mg/l	0.9									
Selenium as Se, mg/l										0.000
Silver as Ag, mg/l										0.00
Sodium as Na, mg/l		9.0	8.0	10	10	20		35	30	
Sodium, dis., as Na, mg/l	7.7									
INORGANIC ANALYSIS										
Alkalinity, Total, as CaCO3, mg/l	10	18	11	15	9	27	17	48	57	
Bicarbonates as HCO3, mg/l	12						21			
Boron as B, mg/l										
Carbonates as CO3, mg/l	0						0			
Carbon Dioxide as CO2, mg/l	12									
Chloride as Cl, mg/l		10	9	10	15	14		10	14	
Chloride, dis., as Cl, mg/l	11						11			
Fluoride as F, mg/l	0.1						0.2			0.6
Fluoride, dis., as F, mg/l										
Hardness, Total, as CaCO3, mg/l	24	17	17	18	35	21	21	16	24	
Hardness, Non-carbonate, as CaCO3, mg/l	15					3				

*1. Mass. DEQE
2. Brooks AFB
3. USGS
4. Unknown

WATER QUALITY DATA - WELL G 12/71 - 1/79

Sample Date	12/71	4/2/74	1/28/75	5/12/75	12/1/75	3/2/76	4/76	8/30/76	3/20/7	1/21/79
Laboratory	3	4	4	4	4	4	3	4	4	1
Nitrogen, Ammonia, as N, mg/l		0.00	0.01	0.00	0.00	0.00		0.00	0.00	
Nitrogen, Ammonia, dis., as N, mg/l							0.020			
Nitrogen, Ammon. + Org., as N, mg/l, dis.							0.23			
Nitrogen, Nitrate, as N, mg/l	0.41	0.5	0.3	0.4	5.9	1.8		1.0	3.0	0.5
Nitrogen, Nitrate, dis., as N, mg/l							0.43			
Nitrogen, Nitrite, as N, mg/l		0.000	0.000	0.000	0.000	0.000		0.000	0.000	
Nitrogen, Nitrite, dis., as N, mg/l							0.010			
Nitrogen, Organic, dis., as N, mg/l							0.21			
Oxygen, dissolved, mg/l							10.2			
pH units	6.2	6.1	6.2	(.5	6.1	6.5	5.5	7.1	7.1	
Phosphate, Ortho, dis., as P, mg/l							0.140			
Phosphate, Total, dis., as P, mg/l							0.260			
Silica, as SiO2, mg/l		12	9.1	10	5.6	7.4		13	12	
Silica, as SiO2, dis., mg/l	11						11			
Sulfate as SO4, mg/l		9	9	9	0	0		13	0	
Sulfate, dis., as SO4, mg/l	16						12			
Surfactants, (MBAS), mg/l										
ORGANIC ANALYSIS										
Methylene Chloride, ug/l										
1,1-dichloroethylene, ug/l										
1,1-dichloroethane, ug/l										
1,2-trans-dichloroethylene, ug/l										
Chlorofrom, ug/l										
1,2-dichloroethane, ug/l										
1,1,1-trichloroethane, ug/l										
Carbon tetrachloride, ug/l										
Dichlorobromomethane, ug/l										
Trichloroethylene, ug/l										
Dibromochloromethane, ug/l										
Bromoform, ug/l										
Tetrachloroethylene, ug/l										
1,2-dichloroethylene, ug/l										
1,1,2,2-tetrachloroethylene, ug/l										
Toluene, ug/l										
Phenol, ug/l										
Total Trihalomethanes, ug/l										
Pesticides, ug/l										
Herbicides, ug/l										
Oil, mg/l										
BACTERIOLOGICAL ANALYSIS										
Coliforms, Total, per 100 ml.										
RADIOLOGICAL ANALYSIS										
Gross Alpha Count, P ci/l										
Gross Beta Count. P ci/l										
MISC. ANALYSIS										
Sodium Adsorption Ratio	0.7									

WATER QUALITY DATA - WELL G 6/79 - 5/81

Sample Date	6/29/79	7/2/79	7/17/79	9/26/79	1/16/80	1/17/80	6/10/80	5/29/81	5/11/81
Laboratory*	4	4	4	4	4	1	4	1	1
PHYSICAL EXAMINATION									
Color, PCU	0		0		3			0	
Odor, TON	0		0		0			0	
Sediment, ml	0		0		0			0	
Solids, Residue at 180 deg C, dis., mg/l									
Solids, sum of, dis., mg/l									
Specific Conductance umhos/cm.	94		93		140			96	
Temp., deg. C									
Turbidity, NTU	0.3		0.3		0.9			0.1	
METAL ANALYSIS									
Arsenic as As, mg/l									0.000
Barium as Ba, mg/l									<0.10
Cadmium as Cd, mg/l									0.00
Calcium as Ca, mg/l	4.3		4.3		6.5			5.1	
Calcium, dis., as Ca, mg/l									
Chromium as Cr, mg/l									0.00
Copper as Cu, mg/l	0.02		0.01		0.04			0.01	
Iron as Fe, mg/l	0.00		0.04		0.22			0.00	
Lead as Pb, mg/l									0.00
Magnesium as Mg, mg/l	2.2		2.3		5.5			3.3	
Magnesium, dis., as Mg, mg/l									
Manganese as Mn, mg/l	0.00		0.02		0.00			0.00	
Mercury as Hg, mg/l									0.0001
Potassium as K, mg/l	0.7		0.7		1.1			1.1	
Potassium, dis., as K, mg/l									
Selenium as Se, mg/l									0.002
Silver as Ag, mg/l									0.00
Sodium as Na, mg/l	10		10		7.8	17		8.1	9.1
Sodium, dis., as Na, mg/l									
INORGANIC ANALYSIS									
Alkalinity, Total, as CaCO3, mg/l	14		13		8			14	
Bicarbonates as HCO3, mg/l									
Boron as B, mg/l	0.0								
Carbonates as CO3, mg/l									
Carbon Dioxide as CO2, mg/l									
Chloride as Cl, mg/l	11		11		11			14	
Chloride, dis., as Cl, mg/l									
Fluoride as F, mg/l									<0.10
Fluoride, dis., as F, mg/l									
Hardness, Total, as CaCO3, mg/l	20		20		38			27	
Hardness, Non-carbonate, as CaCO3, mg/l									

*1. Mass. DEQE
2. Brooks AFB
3. USGS
4. Unknown

WATER QUALITY DATA - WELL G 6/79 - 5/81

Sample Date	6/26/79	7/2/79	7/17/79	9/26/79	1/16/80	1/17/80	6/10/80	4/29/81	5/11/81
Laboratory	4	4	4	4	4	1	4	1	1
Nitrogen, Ammonia, as N, mg/l	0.01		0.01		0.01			0.00	
Nitrogen, Ammonia, dis., as N, mg/l									
Nitrogen, Ammon. + Org., as N, mg/l									
Nitrogen, Nitrate, as N, mg/l	0.4		0.4		5.0			1.2	0.6
Nitrogen, Nitrate, dis., as N, mg/l									
Nitrogen, Nitrite, as N, mg/l	0.000		0.000		0.000			0.000	
Nitrogen, Nitrite, dis., as N, mg/l									
Nitrogen, Organic, dis., as N, mg/l									
Oxygen, dissolved, mg/l									
pH units	6.3		6.2		5.8			6.2	
Phosphate, Ortho, dis., as P, mg/l									
Phosphate, Total, dis., as P, mg/l									
Silica, as SiO2, mg/l	11		10		7.3			11.	
Silica, as SiO2, dis., mg/l									
Sulfate as SO4, mg/l	11		12		16			12.	
Sulfate, dis., as SO4, mg/l									
Surfactants, (MBAS), mg/l	0.00								
ORGANIC ANALYSIS									
Methylene Chloride, ug/l				ND					ND
1,1-dichloroethylene, ug/l			ND	ND					ND
1,1-dichloroethane, ug/l									ND
1,2-trans-dichloroethylene, ug/l									ND
Chlorofrom, ug/l				2.3					1.1
1,2-dichloroethane, ug/l			ND	ND					ND
1,1,1-trichloroethane, ug/l			12.8	10.4					5.0
Carbon tetrachloride, ug/l									ND
Dichlorobromomethane, ug/l				3.5					ND
Trichloroethylene, ug/l	8.0	8.0	ND	1.5			ND		0.7
Dibromochloromethane, ug/l				2.9					ND
Bromoform, ug/l				ND					ND
Tetrachloroethylene, ug/l	2.1	2.1	0.9	2.2					2.1
1,2-dichloroethylene, ug/l			ND	ND					
1,1,2,2-tetrachloroethylene, ug/l									
Toluene, ug/l									
Phenol, ug/l									
Total Trihalomethanes, ug/l			ND						
Pesticides, ug/l									ND
Herbicides, ug/l									ND
Oil, mg/l									
BACTERIOLOGICAL ANALYSIS									
Coliforms, Total, per 100 ml.									0
RADIOLOGICAL ANALYSIS									
Gross Alpha Count, P ci/l									<1.0
Gross Beta Count. P ci/l									1.5
MISC. ANALYSIS									
Sodium Adsorption Ratio									

ND = None Detected

WATER QUALITY DATA - WELL G 7/81 - 4/82

Sample Date	7/21/81	7/21/81	8/25/81	8/25/81	9/23/81	10/27/81	10/27/81	1/19/82	3/29/82	4/28/82
Laboratory*	2	1	2	1	2	1	2	2	1	2
PHYSICAL EXAMINATION										
Color, PCU									5	
Odor, TON									0	
Sediment, ml									0	
Solids, Residue at 180 deg C, dis., mg/l										
Solids, sum of, dis., mg/l										
Specific Conductance umhos/cm.									86	
Temp., deg. C										
Turbidity, NTU									0.6	
METAL ANALYSIS										
Arsenic as As, mg/l										
Barium as Ba, mg/l										
Cadmium as Cd, mg/l										
Calcium as Ca, mg/l									3.6	
Calcium, dis., as Ca, mg/l										
Chromium as Cr, mg/l										
Copper as Cu, mg/l									0.11	
Iron as Fe, mg/l									0.02	
Lead as Pb, mg/l										
Magnesium as Mg, mg/l									2.3	
Magnesium, dis., as Mg, mg/l										
Manganese as Mn, mg/l									0.00	
Mercury as Hg, mg/l										
Potassium as K, mg/l									0.8	
Potassium, dis., as K, mg/l										
Selenium as Se, mg/l										
Silver as Ag, mg/l										
Sodium as Na, mg/l									8.7	
Sodium, dis., as Na, mg/l										
INORGANIC ANALYSIS										
Alkalinity, Total, as CaCO3, mg/l									11	
Bicarbonates as HCO3, mg/l										
Boron as B, mg/l										
Carbonates as CO3, mg/l										
Carbon Dioxide as CO2, mg/l										
Chloride as Cl, mg/l									11	
Chloride, dis., as Cl, mg/l										
Fluoride as F, mg/l										
Fluoride, dis., as F, mg/l										
Hardness, Total, as CaCO3, mg/l									18	
Hardness, Non-carbonate, as CaCO3, mg/l										

*1. Mass. DEQE
2. Brooks AFB
3. USGS
4. Unknown

WATER QUALITY DATA - WELL G 7/81 - 4/82

Sample Date	7/21/81	7/21/81	8/25/81	8/25/81	9/23/81	10/27/81	10/27/81	1/19/82	3/29/82	4/28/82
Laboratory	2	1	2	1	2	1	2	2	1	2
Nitrogen, Ammonia, as N, mg/l									0.01	
Nitrogen, Ammonia, dis., as N, mg/l										
Nitrogen, Ammon. + Org., as N, mg/l										
Nitrogen, Nitrate, as N, mg/l										
Nitrogen, Nitrate, dis., as N, mg/l									0.6	
Nitrogen, Nitrite, as N, mg/l									0.000	
Nitrogen, Nitrite, dis., as N, mg/l										
Nitrogen, Organic, dis., as N, mg/l										
Oxygen, dissolved, mg/l										
pH units									6.0	
Phosphate, Ortho, dis., as P, mg/l										
Phosphate, Total, dis., as P, mg/l										
Silica, as SiO2, mg/l										
Silica, as SiO2, dis., mg/l										
Sulfate as SO4, mg/l									8	
Sulfate, dis., as SO4, mg/l										
Surfactants, (MBAS), mg/l										
ORGANIC ANALYSIS										
Methylene Chloride, ug/l	ND						ND <0.2	ND<0.2		ND <0.2
1,1-dichloroethylene, ug/l	ND									ND <0.1
1,1-dichloroethane, ug/l	ND							ND<0.1		ND <0.1
1,2-trans-dichloroethylene, ug/l	ND						ND <0.1	ND<0.1		ND <0.1
Chlorofrom, ug/l	0.3	2.2	0.6	<1.0	0.8	1.1		0.6		0.5
1,2-dichloroethane, ug/l	ND						ND <0.2	ND<0.1		
1,1,1-trichloroethane, ug/l	2.5	3.0	3.0	4.0	0.3	3.4	3.9	ND<0.1		ND <0.1
Carbon tetrachloride, ug/l	4.0	4.7	5.5	4.7	0.3	2.6	5.1	ND<0.1		3.0
Dichlorobromomethane, ug/l	ND				0.2	1.0	ND <0.1	TR<0.2		ND <0.1
Trichloroethylene, ug/l	0.7	1.0	0.9			<1.0	1.0	ND<0.1		
Dibromochloromethane, ug/l	ND				1.8	<1.0	TR <0.2	TR<0.2		ND <0.1
Bromoform, ug/l	ND				0.7		ND <0.2	ND<0.2		ND <0.2
Tetrachloroethylene, ug/l		2.5		2.8		3.0				
1,2-dichloroethylene, ug/l										
1,1,2,2-tetrachloroethylene, ug/l	1.9		2.3		0.5		3.0	ND<0.1		2.2
Toluene, ug/l						1.5				
Phenol, ug/l										
Total Trihalomethanes, ug/l										
Pesticides, ug/l										
Herbicides, ug/l										
Oil, mg/l										
BACTERIOLOGICAL ANALYSIS										
Coliforms, Total, per 100 ml.										
RADIOLOGICAL ANALYSIS										
Gross Alpha Count, P ci/l										
Gross Beta Count. P ci/l										
MISC. ANALYSIS										
Sodium Adsorption Ratio										

ND = None Detected TH = Trace

WATER QUALITY DATA - WELL J 5/48 - 8/59

Sample Date	5/19/48	6/27/51	3/18/53	9/14/53	5/3/55	4/3/56	11/6/56	9/25/57	8/19/58	8/20/59
Laboratory*	3	3	3	3	3	3	3	3	3	3
PHYSICAL EXAMINATION										
Color, PCU	2	3	0	4	5	3	3	2	2	2
Odor, TON										
Sediment, ml/L										
Solids, Residue at 180 deg C, dis., mg/l	38	76	62	61	111	99	101	84	99	42
Solids, sum of, dis., mg/l	38	70	58	58	105	100	93	82	9[illegible]	40
Specific Conductance umhos/cm.	59	104	88	98	155	167	165	140	1[illegible]4	63
Temp., deg. C		10.5		13.9		8.9	11.1	12.2	[illegible].4	16.7
Turbidity, NTU										
METAL ANALYSIS										
Arsenic as As, mg/l										
Barium as Ba, mg/l										
Cadmium as Cd, mg/l										
Calcium as Ca, mg/l										
Calcium, dis., as Ca, mg/l	1.7	3.8	2.0	3.2	3.6	6.4	7.0	6.[illegible]	7.6	2.7
Chromium as Cr, mg/l										
Copper as Cu, mg/l										
Iron as Fe, mg/l	0.08	0.15	0.06	0.03	0.14	0.09	0.0[illegible]	0.03	-	0.04
Lead as Pb, mg/l										
Magnesium as Mg, mg/l										
Magnesium, dis., as Mg, mg/l	1.6	4.2	1.1	2.9	2.7	4.7	6.3	4.6	7.8	1.2
Manganese as Mn, mg/l						0.01	0.03			0.06
Mercury as Hg, mg/l										
Potassium as K, mg/l										
Potassium, dis., as K, mg/l										
Selenium as Se, mg/l										
Silver as Ag, mg/l										
Sodium as Na, mg/l										
Sodium, dis., as Na, mg/l										
INORGANIC ANALYSIS										
Alkalinity, Total, as CaCO3, mg/l	5	22	21	7	25	21	[illegible]	5	6	19
Bicarbonates as HCO3, mg/l	6	27	26	8	30	25	8	6	7	12
Boron as B, mg/l										
Carbonates as CO3, mg/l	0	0	0	0	0	0	0	0	0	0
Carbon Dioxide as CO2, mg/l	9.5	27	6.5	10	1.8	1.5	1.6	19	11	24
Chloride as Cl, mg/l										
Chloride, dis., as Cl, mg/l	9.6	18	[illegible].0	16	17	17	18	17	17	5.8
Fluoride as F, mg/l										
Fluoride, dis., as F, mg/l	0.0	0.1	0.2	0.0	0.3	0.0	0.1	0.1	0.0	0.0
Hardness, Total, as CaCO3, mg/l	10	26	9	19	20	35	43	34	51	11
Hardness, Non-carbonate, as CaCO3, mg/l	5	4	-11	13	-4	14	36	29	45	1

*1. Mass. DEQE
2. Brooks AFB
3. USGS
4. Unknown

WATER QUALITY DATA - WELL J 9/61 - 10/71

Sample Date	9/27/61	6/25/62	11/6/62	1/27/64	11/8/65	12/29/66	5/8/67	11/28/67	11/29/6	10/26/71
Laboratory*	3	1	3	3	3	3	1	3	3	1
PHYSICAL EXAMINATION										
Color, PCU	2	10	1	1	1	1	0	1	2	0
Odor, TON		0					0			0
Sediment, ml/L		0					0			0
Solids, Residue at 180 deg C, dis., mg/l	85		82	86	101	91		78	76	
Solids, sum of, dis., mg/l	77		80	70	102	86		65	63	
Specific Conductance umhos/cm.	137		136	139	181	134		134	127	
Temp., deg. C	12.2			10.0	10.5	10.0				
Turbidity, NTU		0					0			0
METAL ANALYSIS										
Arsenic as As, mg/l										
Barium as Ba, mg/l										
Cadmium as Cd, mg/l										
Calcium as Ca, mg/l										
Calcium, dis., as Ca, mg/l	5.8		6.9	6.6	8.9	7.3		8.1	6.0	
Chromium as Cr, mg/l										
Copper as Cu, mg/l										
Iron as Fe, mg/l	0.10	0.08		0.08	0.07	0.06	0.02			0.09
Lead as Pb, mg/l										
Magnesium as Mg, mg/l										
Magnesium, dis., as Mg, mg/l	5.7		6.1	5.0	9.0	5.5		4.1	5.3	
Manganese as Mn, mg/l	0	0.06		0.05	0.06	0.07	0.02			0.00
Mercury as Hg, mg/l										
Potassium as K, mg/l										
Potassium, dis., as K, mg/l										
Selenium as Se, mg/l										
Silver as Ag, mg/l										
Sodium as Na, mg/l										
Sodium, dis., as Na, mg/l										8
INORGANIC ANALYSIS										
Alkalinity, Total, as CaCO3, mg/l	6	7	7	5	5	8	5	7	8	11
Bicarbonates as HCO3, mg/l	7		8	6	6	10		9	10	
Boron as B, mg/l										
Carbonates as CO3, mg/l	0		0	0	0	0		0	0	
Carbon Dioxide as CO2, mg/l	11		12	12	12	15				
Chloride as Cl, mg/l		9.5					15			13
Chloride, dis., as Cl, mg/l	13		14	14	17	14		14	14	
Fluoride as F, mg/l										
Fluoride, dis., as F, mg/l	0.4		0.0	0.1	0.2	0.6		0.1	0.2	
Hardness, Total, as CaCO3, mg/l	37	20	42	37	59	40	46	37	36	30
Hardness, Non-carbonate, as CaCO3, mg/l	32		35	32	54	32		29	28	

*1. Mass. DEQE
2. Brooks AFB
3. USGS
4. Unknown

WATER QUALITY DATA - WELL J 5/48 - 8/59

Sample Date	5/19/48	6/27/51	3/18/53	9/14/53	5/3/55	4/3/56	11/6/56	9/25/57	8/19/58	8/20/59
Laboratory	3	3	3	3	3	3	3	3	3	3
Nitrogen, Ammonia, as N, mg/l										
Nitrogen, Ammonia, dis., as N, mg/l										
Nitrogen, Ammon. + Org., as N, mg/l										
Nitrogen, Nitrate, as N, mg/l	0.84	1.5	0.11	1.5	3.2	3.8	4.3	3.6	3.8	0.41
Nitrogen, Nitrate, dis., as N, mg/l										
Nitrogen, Nitrite, as N, mg/l										
Nitrogen, Nitrite, dis., as N, mg/l										
Nitrogen, Organic, dis., as N, mg/l										
Oxygen, dissolved, mg/l										
pH units	6.0	6.2	6.8	6.1	7.4	7.4	6.9	5.7	6.0	5.9
Phosphate, Ortho, dis., as P, mg/l										
Phosphate, Total, dis., as P, mg/l										
Silica, as SiO2, mg/l										
Silica, as SiO2, dis., mg/l	7.5	8.5	1.3	7.8	16	12	10	8.9	8.4	9.4
Sulfate as SO4, mg/l										
Sulfate, dis., as SO4, mg/l	3.8	1.5	5.6	7.0	12	14	18	15	26	6.5
Surfactants, (MBAS), mg/l										
ORGANIC ANALYSIS										
Methylene Chloride, ug/l										
1,1-dichloroethylene, ug/l										
1,1-dichloroethane, ug/l										
1.2-trans-dichloroethylene, ug/l										
Chlorofrom, ug/l										
1,2-dichloroethane, ug/l										
1,1,1-trichloroethane, ug/l										
Carbon tetrachloride, ug/l										
Dichlorobromomethane. ug/l										
Trichloroethylene, ug/l										
Dibromochloromethane, ug/l										
Bromoform, ug/l										
Tetrachloroethylene, ug/l										
1,2-dichloroethylene, ug/l										
1,1,2,2-tetrachoroethylene, ug/l										
Toluene, ug/l										
Phenol, ug/l										
Total Trihalomethanes, ug/l										
Pesticides, ug/l										
Herbicides, ug/l										
Oil, mg/l										
BACTERIOLOGICAL ANALYSIS										
Coliforms, Total, per 100 ml.										
RADIOLOGICAL ANALYSIS										
Gross Alpha Count, P ci/l										
Gross Beta Count. P ci/l										
MISC. ANALYSIS										
Sodium Adsorption Ratio										

WATER QUALITY DATA - WELL J 9/61 - 10/71

Sample Date	9/27/61	6/25/62	11/6/62	1/27/62	11/8/65	12/29/66	5/8/67	11/28/67	11/29/6	10/26/71
Laboratory	3	1	3	3	3	3	1	3	3	1
Nitrogen, Ammonia, as N, mg/l										0.00
Nitrogen, Ammonia, dis., as N, mg/l										
Nitrogen, Ammon. + Org., as N, mg/l										
Nitrogen, Nitrate, as N, mg/l	3.6	3.6	4.3	4.3	6.6	3.4	4.4	3.4	2.3	4.0
Nitrogen, Nitrate, dis., as N, mg/l										
Nitrogen, Nitrite, as N, mg/l		0.00					0.001			0.000
Nitrogen, Nitrite, dis., as N, mg/l										
Nitrogen, Organic, dis., as N, mg/l										
Oxygen, dissolved, mg/l										
pH units	6.0	5.9	6.0	5.9	5.9	6.0	6.1	6.1	6.1	6.3
Phosphate, Ortho, dis., as P, mg/l										
Phosphate, Total, dis., as P, mg/l										
Silica, as SiO2, mg/l										
Silica, as SiO2, dis., mg/l	8.7		8.4	8.2	8.3	9.3		8.9	8.7	
Sulfate as SO4, mg/l										
Sulfate, dis., as SO4, mg/l	16		15	15	20	20		18	17	
Surfactants, (MBAS), mg/l										
ORGANIC ANALYSIS										
Methylene Chloride, ug/l										
1,1-dichloroethylene, ug/l										
1,1-dichloroethane, ug/l										
1,2-trans-dichloroethylene, ug/l										
Chlorofrom, ug/l										
1,2-dichloroethane, ug/l										
1,1,1-trichloroethane, ug/l										
Carbon tetrachloride, ug/l										
Dichlorobromomethane, ug/l										
Trichloroethylene, ug/l										
Dibromochloromethane, ug/l										
Bromoform, ug/l										
Tetrachloroethylene, ug/l										
1,2-dichloroethylene, ug/l										
1,1,2,2-tetrachoroethylene, ug/l										
Toluene, ug/l										
Phenol, ug/l										
Total Trihalomethanes, ug/l										
Pesticides, ug/l										
Herbicides, ug/l										
Oil, mg/l										
BACTERIOLOGICAL ANALYSIS										
Coliforms, Total, per 100 ml.										
RADIOLOGICAL ANALYSIS										
Gross Alpha Count, P ci/l										
Gross Beta Count. P ci/l										
MISC. ANALYSIS										
Sodium Adsorption Ratio								0.5	0.4	

WATER QUALITY DATA - WELL J 12/71 - 9/79

Sample Date	12/28/71	4/2/74	1/28/75	5/12/75	12/1/75	3/2/76	4/20/76	8/30/76	3/20/78	9/26/79
Laboratory*	3	1	1	1	1	1	3	1	1	1
PHYSICAL EXAMINATION										
Color, PCU		0	0	0	3	3		0	10	0
Odor, TON		0	0	0	0	0		0	0	0
Sediment, ml/L		0	0	0	0	0		0	0	0
Solids, Residue at 180 deg C, dis., mg/l	90									
Solids, sum of, dis., mg/l	70						81			
Specific Conductance umhos/cm.	146	114	136	160	122	120	132	120	124	220
Temp., deg. C	12.0						10.0			
Turbidity, NTU		0	0	1	0	0		0	0.1	0.3
METAL ANALYSIS										
Arsenic as As, mg/l							0			
Barium as Ba, mg/l										
Cadmium as Cd, mg/l							0			
Calcium as Ca, mg/l		5.0	5.5	9.0	6.0	5.8		6.5	5.2	14
Calcium, dis., as Ca, mg/l	8.5						8.1			
Chromium as Cr, mg/l							0.01			
Copper as Cu, mg/l		0.02	0.02	0.03	0.37	0.04	0	0.00	0.00	0.06
Iron as Fe, mg/l	0.02	0.00	0.02	0.20	0.03	0.00	0.04	0.03	0.00	0.02
Lead as Pb, mg/l							0.001			
Magnesium as Mg, mg/l		5.0	5.5	2.2	5.3	5.0		5.2	4.6	10
Magnesium, dis., as Mg, mg/l	7.1						5.1			
Manganese as Mn, mg/l	0.04	0.01	0.02	0.00	0.03	0.01	0.02	0.02	0.01	0.00
Mercury as Hg, mg/l							<0.0005			
Potassium as K, mg/l		1.2	1.5	1.1	1.2	1.1		1.5	0.9	2.2
Potassium, dis., as K, mg/l	1.4						1.2			
Selenium as Se, mg/l							0			
Silver as Ag, mg/l										
Sodium as Na, mg/l		7.0	7.0	25	7.5	6.5		8.0	8.0	7.2
Sodium, dis., as Na, mg/l	6.1						6.6			
INORGANIC ANALYSIS										
Alkalinity, Total, as CaCO3, mg/l	7	14	8	49	8	5	7	-	14	10
Bicarbonates as HCO3, mg/l	8						8			
Boron as B, mg/l										
Carbonates as CO3, mg/l	0						0			
Carbon Dioxide as CO2, mg/l	16						63			
Chloride as Cl, mg/l		14	13	13	14	14		15	13	12
Chloride, dis., as Cl, mg/l	12						12			
Fluoride as F, mg/l										
Fluoride, dis., as F, mg/l	0.1						0.1			
Hardness, Total, as CaCO3, mg/l	50						41			
Hardness, Non-carbonate, as CaCO3, mg/l	43						34			

*1. Mass. DEQE
2. Brooks AFB
3. USGS
4. Unknown

WATER QUALITY DATA - WELL J 12/71 - 9/79

Sample Date	12/28/71	4/2/74	1/28/75	5/12/75	12/1/75	3/2/76	4/20/76	8/30/76	3/20/78	9/26/79
Laboratory	3	1	1	1	1	1	3	1	1	1
Nitrogen, Ammonia, as N, mg/l		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.01
Nitrogen, Ammonia, dis., as N, mg/l							0.000			
Nitrogen, Ammon. + Org., as N, mg/l										
Nitrogen, Nitrate, as N, mg/l	4.1	4.3	5.0	0.5	6.0	6.0		4.8	5.7	0.1
Nitrogen, Nitrate, dis., as N, mg/l							5.2			
Nitrogen, Nitrite, as N, mg/l	0.000	0.001	0.000	0.000	0.000	0.000		0.000	0.000	0.000
Nitrogen, Nitrite, dis., as N, mg/l							0.000			
Nitrogen, Organic, dis., as N, mg/l							0.05			
Oxygen, dissolved, mg/l							9.0			
pH units	5.9	5.9	6.0	7.1	5.9	6.0	5.3	5.9	6.4	5.7
Phosphate, Ortho, dis., as P, mg/l							0.03			
Phosphate, Total, dis., as P, mg/l							0.05			
Silica, as SiO2, mg/l		8.7	7.1	9.4	6.6	6.5		9.7	9.6	9.8
Silica, as SiO2, dis., mg/l	8.5						8.6			
Sulfate as SO4, mg/l		12	14	0	14	14		5	15	36
Sulfate, dis., as SO4, mg/l	23						13			
Surfactants, (MBAS), mg/l										
ORGANIC ANALYSIS										
Methylene Chloride, ug/l										ND
1,1-dichloroethylene, ug/l										ND
1,1-dichloroethane, ug/l										
1.2-trans-dichloroethylene, ug/l										ND
Chlorofrom, ug/l										ND
1,2-dichloroethane, ug/l										ND
1,1,1-trichloroethane, ug/l										
Carbon tetrachloride, ug/l										ND
Dichlorobromomethane. ug/l										ND
Trichloroethylene, ug/l										ND
Dibromochloromethane, ug/l										ND
Bromoform, ug/l										ND
Tetrachloroethylene, ug/l										ND
1,2-dichloroethylene, ug/l										
1,1,2,2-tetrachoroethylene, ug/l										
Toluene, ug/l										
Phenol, ug/l										
Total Trihalomethanes, ug/l										
Pesticides, ug/l										
Herbicides, ug/l							ND			
Oil, mg/l							ND			
BACTERIOLOGICAL ANALYSIS										
Coliforms, Total, per 100 ml.										
RADIOLOGICAL ANALYSIS										
Gross Alpha Count, P ci/l										
Gross Beta Count. P ci/l										
MISC. ANALYSIS										
Sodium Adsorption Ratio	0.3						0.4			

ND=None Detected

WATER QUALITY DATA - WELL J 1/80 - 3/82

Sample Date	1/16/80	4/29/81	3/29/82
Laboratory*	1	1	1
PHYSICAL EXAMINATION			
Color, PCU	0	5	0
Odor, TON	0	0	0
Sediment, ml/L	0	0	0
Solids, Residue at 180 deg C, dis., mg/l			
Solids, sum of, dis., mg/l			
Specific Conductance umhos/cm.	130	120	120
Temp., deg. C			
Turbidity, NTU	0.2	0.1	0.2
METAL ANALYSIS			
Arsenic as As, mg/l			
Barium as Ba, mg/l			
Cadmium as Cd, mg/l			
Calcium as Ca, mg/l	6.7	6.2	5.9
Calcium, dis., as Ca, mg/l			
Chromium as Cr, mg/l			
Copper as Cu, mg/l	0.00	0.00	0.01
Iron as Fe, mg/l	0.00	0.02	0.00
Lead as Pb, mg/l			
Magnesium as Mg, mg/l	5.7	4.5	4.6
Magnesium, dis., as Mg, mg/l			
Manganese as Mn, mg/l	0.02	0.02	0.00
Mercury as Hg, mg/l			
Potassium as K, mg/l	1.1	1.0	0.9
Potassium, dis., as K, mg/l			
Selenium as Se, mg/l			
Silver as Ag, mg/l			
Sodium as Na, mg/l	6.8	6.7	6.4
Sodium, dis., as Na, mg/l			
INORGANIC ANALYSIS			
Alkalinity, Total, as CaCO3, mg/l	8	6	7
Bicarbonates as HCO3, mg/l			
Boron as B, mg/l			
Carbonates as CO3, mg/l			
Carbon Dioxide as CO2, mg/l			
Chloride as Cl, mg/l	10	11	59
Chloride, dis., as Cl, mg/l			
Fluoride as F, mg/l			
Fluoride, dis., as F, mg/l			
Hardness, Total, as CaCO3, mg/l	40	34	34
Hardness, Non-carbonate, as CaCO3, mg/l			

*1. Mass. DEQE
2. Brooks AFB
3. USGS
4. Unknown

WATER QUALITY DATA - WELL J 1/80 - 3/82

Sample Date	1/16/80	4/29/81	3/29/82
Laboratory	1	1	1
Nitrogen, Ammonia, as N, mg/l	0.01	0.00	0.00
Nitrogen, Ammonia, dis., as N, mg/l			
Nitrogen, Ammon. + Org., as N, mg/l			
Nitrogen, Nitrate, as N, mg/l	5.2	3.2	3.0
Nitrogen, Nitrate, dis., as N, mg/l			
Nitrogen, Nitrite, as N, mg/l	0.000	0.000	0.001
Nitrogen, Nitrite, dis., as N, mg/l			
Nitrogen, Organic, dis., as N, mg/l			
Oxygen, dissolved, mg/l			
pH units	5.8	5.7	5.75
Phosphate, Ortho, dis., as P, mg/l			
Phosphate, Total, dis., as P, mg/l			
Silica, as SiO2, mg/l	8.3	11	
Silica, as SiO2, dis., mg/l			
Sulfate as SO4, mg/l	14	19	19.8
Sulfate, dis., as SO4, mg/l			
Surfactants, (MBAS), mg/l			
ORGANIC ANALYSIS			
Methylene Chloride, ug/l			
1,1-dichloroethylene, ug/l			
1,1-dichloroethane, ug/l			
1.2-trans-dichloroethylene, ug/l			
Chlorofrom, ug/l			
1,2-dichloroethane, ug/l			
1,1,1-trichloroethane, ug/l			
Carbon tetrachloride, ug/l			
Dichlorobromomethane. ug/l			
Trichloroethylene, ug/l			
Dibromochloromethane, ug/l			
Bromoform, ug/l			
Tetrachloroethylene, ug/l			
1,2-dichloroethylene, ug/l			
1,1,2,2-tetrachoroethylene, ug/l			
Toluene, ug/l			
Phenol, ug/l			
Total Trihalomethanes, ug/l			
Pesticides, ug/l			
Herbicides, ug/l			
Oil, mg/l			
BACTERIOLOGICAL ANALYSIS			
Coliforms, Total, per 100 ml.			
RADIOLOGICAL ANALYSIS			
Gross Alpha Count, P ci/l			
Gross Beta Count. P ci/l			
MISC. ANALYSIS			
Sodium Adsorption Ratio			

APPENDIX D

U.S. EPA EXISTING AND PROPOSED SUGGESTED NO ADVERSE RESPONSE LEVELS (SNARLS) FOR CERTAIN ORGANIC CHEMICALS AND RESULTS OF ORGANIC CHEMICAL ANALYSES FROM MONITORING WELLS INSTALLED FOR USGS PLUME STUDY

TABLE D-1. U.S. EPA SUGGESTED NO ADVERSE RESPONSE LEVELS (SNARLS) FOR CERTAIN ORGANIC CHEMICALS

EXISTING SNARLS

Chemical	Concentration (lifetime exposure)
Trichloroethylene	.075 mg/l
Tetrachloroethylene	.040 mg/l
1,1 Trichloroethane	1.0 mg/l

PROPOSED SNARLS

Chemical	Concentration (lifetime exposure)
Methylene chloride	.150 mg/l
1,1 Dichloroethylene	.070 mg/l
1,2 Transdichloroethylene	.27 mg/l

TABLE D-2. RESULTS OF ORGANIC CHEMICAL ANALYSES FROM MONITORING WELLS INSTALLED FOR USGS PLUME STUDY

Parameter	USGS Well number			
	FSW 194	FSW 214	FSW 233	FSW 258
Methylene Chloride	nd	nd	nd	nd
1,1 Dichloroethylene	0.1	nd	nd	nd
1,1 dichloroethane	0.1	nd	nd	0.7
1,2 Transdichloroethylene	3.3	nd	nd	3.6
Chloroform	0.3	0.7	nd	nd
1,2 Dichloroethane	nd	nd	nd	nd
1,1,1 Trichloroethane	1.0	nd	nd	nd
Carbon tetrachloride	nd	nd	nd	nd
Bromodichloromethane	nd	nd	nd	nd
Trichloroethylene	23.9	nd	nd	6.5
Dibromochloromethane	nd	nd	nd	nd
Bromoform	nd	nd	nd	nd
Tetrachloroethylene	8.8	6.0	nd	15.6
RFM as TOC	1.4	0.5	14.3	13.1

1. Concentrations in ug/l
2. nd = not detected
3. Samples collected 9/23/80; Analyses by Comm. of Massachusetts Department of Environmental Quality Engineering

APPENDIX E

SITE RATING FORMS

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE Current Firefighting Training Area

LOCATION Otis ANG Base

DATE OF OPERATION OR OCCURRENCE 1958-Present

OWNER/OPERATOR Otis ANG Base

COMMENTS/DESCRIPTION

SITE RATED BY W. F. Diesl/A. Michelini

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	112	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 62

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

100 x 1 = 100

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

100 x 1 = 100

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	8	8	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	50	108

Subscore (100 X factor score subtotal/maximum score subtotal) 46

2. Flooding	0	1	3	0

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Sucsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
		Subtotals	58	114

Subscore (100 x factor score subtotal/maximum score subtotal) 51

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	62
Waste Characteristics	100
Pathways	80
Total 242 divided by 3 =	81 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

81 x 1 = 81

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Former Firefighting Training Area

LOCATION Lingley Road

DATE OF OPERATION OR OCCURRENCE 1950(?)-1958

OWNER/OPERATOR Otis AFB

COMMENTS/DESCRIPTION

SITE RATED BY W. F. Diesl

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	119	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 66

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

100 x 1 = 100

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

100 x 1 = 100

FFTA

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
Subtotals			66	108

Subscore (100 X factor score subtotal/maximum score subtotal) 61

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			58	114

Subscore (100 x factor score subtotal/maximum score subtotal) 51

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 61

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	66
Waste Characteristics	100
Pathways	61

Total 227 divided by 3 = 76 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

76 x 1 = 76

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE Sanitary Landfill

LOCATION Otis ANG Base

DATE OF OPERATION OR OCCURRANCE 1940-Present

OWNER/OPERATOR Otis ANG Base

COMMENTS/DESCRIPTION

SITE RATED BY W. F. Diesl/A. Michelini

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	118	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 66

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

100 x 1.0 = 100

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

100 x .75 = 75

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-wate migration. Select the highest rating, and proceed to C.

1. Surface water migration

				Max.
Distance to nearest surface water	1	8	8	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	50	108

Subscore (100 X factor score subtotal/maximum score subtotal) 46

2. Flooding

Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Depth to ground water	1	8	8	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
		Subtotals	50	114

Subscore (100 x factor score subtotal/maximum score subtotal) 44

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	66
Waste Characteristics	75
Pathways	80
Total 221 divided by 3 =	74
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

74 x 1 = $\boxed{74}$

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE Avgas Fuel Test Dump Site (Constellations, C-121)
LOCATION Otis ANG Base
DATE OF OPERATION OR OCCURRENCE 1950 - 1972
OWNER/OPERATOR Otis ANG Base
COMMENTS/DESCRIPTION
SITE RATED BY W. F. Diesl/A. Michelini

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	118	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 66

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

100 x 1 = 100

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

100 x 1 = 100

Fuel Dumpsite

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	8	8	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	50	108

Subscore (100 X factor score subtotal/maximum score subtotal) 46

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	1	8	8	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
		Subtotals	50	114

Subscore (100 x factor score subtotal/maximum score subtotal) 44

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 46

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	66
Waste Characteristics	100
Pathways	46
Total 212 divided by 3 =	71 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

71 x 1 = 71

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE Railyard Fuel Pumping Station
LOCATION Otis Bldg. 3348
DATE OF OPERATION OR OCCURRENCE 1961-1965
OWNER/OPERATOR Otis ANG Base
COMMENTS/DESCRIPTION
SITE RATED BY W. F. Diesl/A. Michelini

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	115	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 64

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

100 x 1 = 100

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

100 x 1 = 100

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	8	8	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
Subtotals			50	108

Subscore (100 X factor score subtotal/maximum score subtotal) 46

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	1	8	8	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			50	114

Subscore (100 x factor score subtotal/maximum score subtotal) 44

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 46

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	64
Waste Characteristics	100
Pathways	46

Total 210 divided by 3 = 70 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

70 X 1 = 70

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE Non-destructive Test Lab

LOCATION Bldg. 3146 Otis ANG Base

DATE OF OPERATION OR OCCURRENCE 1955-70

OWNER/OPERATOR Otis ANG Base

COMMENTS/DESCRIPTION

SITE RATED BY W. F. Diesl/A. Michelini

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	119	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 66

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

60 x 1 = 60

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

60 x 1 = 60

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore N/A

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	66	108

Subscore (100 X factor score subtotal/maximum score subtotal) 61

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	1	8	8	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
		Subtotals	50	114

Subscore (100 x factor score subtotal/maximum score subtotal) 44

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 61

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	66
Waste Characteristics	60
Pathways	61

Total 187 divided by 3 = 62 Gross Total Score

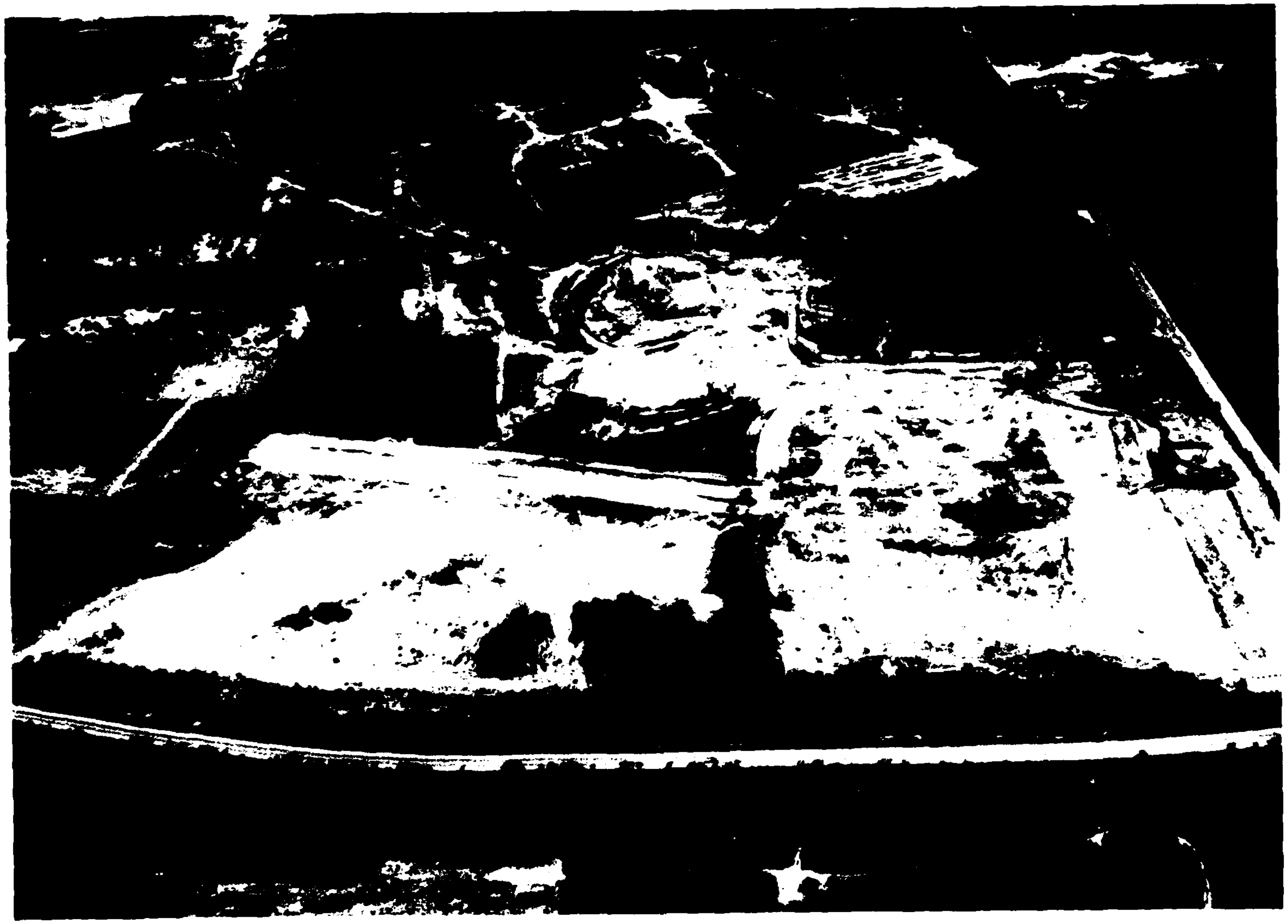
B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

62 x 1 = 62

FIREFIGHTING TRAINING AREA (1982)

FIREFIGHTING TRAINING AREA (1982)
NOTE CONCRETE PAD



BASE LANDFILL (1982)

APPENDIX G

REFERENCES

APPENDIX G

REFERENCES

1. Base Map, no title, 1" = 400' (updated to 1981)

2. Base Map, title "Otis Air Force Base, Jan 1973", 1" = 400'

3. Real Estate Map, Otis Air National Guard Base, 1981

4. SPECIFIC SITES, Phase I Records Search, Annotation on 1967 Pocasset Quadrangle

5. Listing of Current Otis Federal Employees to be interviewed

6. Listing of Former Otis Federal Employees and Position Held to be interviewed

7. Base Telephone Directory

8. Publication - "Air Installation Compatible Use Zone, Otis Air Force Base, Mass. - AICUZ Sept 1980"

9. Report - "1976 Veterans Administration National Cemetery of Bourne, Massachusetts" (10 pages, selected data on site, base history, land use).

10. Water-Table Map of Cape Cod, Massachusetts, Cape Cod Canal to the Bass River, May 23-27, 1976

11. "G" Well Water Quality Data

12. Drawing (print) of Sanitary Landfill Site 1" = 200'

13. Information on Base Sanitary Landfill (7 pages)

14. "Superfund" Site Reporting Notification of Hazardous Waste Site", dtd 29 May 81.

15. "Notification of Hazardous Waste Activity", dtd 17 Sept 81

16. Abstract (1 page) "Dissolved Substances in Ground Water Resulting from Infiltration of Treated Sewage," by Denis R. LeBlanc, U.S. Geological Survey.

17. Aerial Photography (1 sheet) 10/22/51 DPL-2K-80

18. Aerial Photography (1 sheet) Uncontrolled Mosaic, Aerial Photography 28 May 57

19. Aerial Photography (4 Obliques) titled "551st AEW&C Wing 29 Oct 59 135 mm 8000', Otis AFB".

20. Aerial Photography (1 sheet) DPL-2LL-29 dtd 10-6-70

21. Aerial Photography (1 sheet) 23/R 6 July 80

22. Map - Pocasset quadrangle, 1953

23. Map - Pocasset quadrangle, 1967, Photorevised 1979

24. Map - Falmouth Quadrangle, 1972, Photorevised 1979

25. Map - (Quadrangle) Camp Edwards Special Map V 814S, Edition 2 - DMA, Data 1972, 1974

26. Map - (quadrangle) Camp Edwards Special Map Series V814S, Edition 1 - AMS, revised in 1949 by photoplanimetric methods from aerial photography dated 1947

27. Map (has 2 sides) - Photo Map, Pocasset (Camp Edwards and Vicinity), AMS V014A, aerial photography October 1947; and Pocasset quadrangel, compiled in 1948 from aerial photography Sept - Oct 1947.

28. Photo Map, Pocasset, AMS V 014A, aerial photography Oct 1947, restricted edition.

29. Print, Camp Edwards and Vicinity, dated May 12, 1949

30. Subsurface Discharge Permit Application - Otis Air National Guard Base Wastewater Treatment Plant, Oct. 2, 1981.

31. Report - "Soils and Their Interpretations for Various Land Uses - Camp Edwards", December 1980, with aerial Atlas Sheet No. 19 and No. 26 (by U. S. Department of Agriculture, Soil Conservation Service)

32. Final Environmental Impact Statement, Wastewater Collection and Treatment Facilities, Falmouth, Massachusetts, August 1981; note pgs. 7-8.

33. Architect-Engineer's Report on Camp Edwards, June 4, 1941, 284 pgs.

34. Management for Site Investigations: The Preliminary Site Assessment, Part A and Part B, Commonwealth of Massachusetts, Executive Office of Environmental Affairs, Department of Environmental Quality Engineering, Division of Hazardous Waste, November 1980.

35. Groundwater & Groundwater Law in Massachusetts, 2nd Edition, Commonwealth of Massachusetts, Water Resources Commission, Division of Water Resources, 1979.

36. Cape Cod Waste Water Renovation and Retrieval System, A Study of Water Treatment and Conservation, Woods Hole Oceanographic Institution, Woods Hole, Mass., August 1977 (Report on a spray irrigation project at Otis Air Force Base, conducted under a grant from the U.S. Environmental Protection Agency).

37. From U.S. Geological Survey, Water Resources Division, Boston, Mass.; Chemical Quality of Ground Water on Cape Cod, Massachusetts, 1979; Chemical Analysis of Groundwater, Cape Cod, Massachusetts, 1978; Evaluation of Data Availability and Examples of Modeling for Groundwater Management on Cape Cod, Mass., 1975; Groundwater Management - Cape Cod, Martha's Vineyard and Nantucket, 1973; Water Table Map of Cape Cod, 1977.

38. Water Quality Management Plan for Cape Cod, Draft Plan, Final Plan (Volume 1 and Volume 2) 1978. (Comprehensive plan for Water Quality Management prepared under Section 208 of P.L. 92-500 (The Clean Waters Act)). Cape Cod Planning & Economic Development Commission, Barnstable, Massachusetts.

39. Sewage Plume in a Sand and Gravel Aquifer, Cape Cod, Massachusetts, Denis R. LeBlanc, U.S. Geological Survey Open File Report 82-274, 1982.

40. Moncevicz, Donald W., 1982, 102 Fighter Interceptor Wing/ Civil Engineering, Hazardous Waste Study and Inventory, Otis ANG Base Internal Working Paper.

41. "J" Well Water Quality Data.

END

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